

OFFICIAL PUBLICATIONS OF CORNELL UNIVERSITY

VOLUME V

NUMBER 3

ANNOUNCEMENT OF THE GRADUATE SCHOOL 1914-15

JANUARY 15, 1914
PUBLISHED BY CORNELL UNIVERSITY
ITHACA, NEW YORK



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CALENDAR

1914-15

- First term. Sept. 24, 1914. Instruction begins.
 Sept. 26, 1914. Registration of graduate students.
- Second term. Feb. 8, 1915. Registration of graduate students.

1915-16

- First term. Sept. 30, 1915. Instruction begins.
 Oct. 2, 1915. Registration of graduate students.

INDEX

The abbreviations in parentheses indicate the colleges to whose special announcement prospective graduate students are referred for more detailed information concerning advanced work in the various subjects. See page 2. A. & S. = College of Arts and Sciences; Agr. = College of Agriculture; Arch. = College of Architecture; C. E. = College of Civil Engineering; M. E. = Sibley College of Mechanical Engineering; Med. = Medical College; N. Y. Med. = Medical College in New York City; Vet. = Veterinary College; Chem. = Department of Chemistry.

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THE GRADUATE SCHOOL

ADMISSION

The Graduate School has exclusive control of all graduate work carried on in the University. Graduates of the following colleges of Cornell University, namely, the College of Arts and Sciences, the Medical College, the College of Architecture, the College of Civil Engineering, the Sibley College of Mechanical Engineering, and the New York State College of Agriculture,—or of other institutions in which the requirements for the first degree are substantially equivalent,—are eligible for admission to the Graduate School. In other cases, studies pursued after graduation and experience gained by professional work or otherwise are taken into consideration in deciding whether the candidate's preparation as a whole is such as to justify his admission to the Graduate School. Graduates of colleges other than those of Cornell University may be admitted to the Graduate School, but not to candidacy for an advanced degree, in case their training is accepted as less than one year short of that required for the first degree at Cornell University.

Before admission it will be necessary to present evidence of the degree already received, i. e., either the diploma or a statement from some official source. The simplest procedure will ordinarily be to submit an official statement from the registrar or dean that the degree has been conferred. In the case of graduates of Cornell University this is not necessary, since the records are conveniently accessible.

In order to avoid delays at the beginning of the academic year, those who desire to enter the Graduate School are advised to make application for admission, either in person or by letter, in the preceding spring or summer. Correspondence should be addressed to the Dean of the Graduate School, Cornell University, Ithaca, New York.

Seniors in the colleges of Cornell University who have completed the work required for the Bachelor's degree may, under certain conditions to be ascertained from the deans of their respective colleges, be admitted to the Graduate School.

REGISTRATION

Students who have been admitted to the Graduate School are required to register at the office of the Registrar of the University at the beginning of each term, unless special permission for later registration has been granted by the Dean.

STUDIES

All courses of study offered in the University, and all the facilities for study and investigation afforded by its libraries and laboratories, are open to students in the Graduate School, subject only to the condition of their being qualified by previous study or experience to undertake the particular work desired.

A brief statement of the facilities for graduate work in the various departments of the University will be found beginning on page 20 of this Announcement. There is also given a list of courses which are deemed likely to be of profit

to graduate students. More detailed information regarding these courses will be found in the separate announcement of the college in which the particular course is given. The last editions of these special announcements of the various colleges may be obtained gratis and post-free on application to the secretary of the University.

The purpose of the Graduate School is to provide the student with the method and discipline of original research, to the ultimate end that he may contribute to the advancement of knowledge. In furnishing this opportunity for independent study and investigation, the Graduate School seeks to make the conditions such as will enable the student to devote himself wholly to his chosen field. Unhampered by the restrictions that necessarily obtain in undergraduate work, he will come into freedom of association with older scholars, who will seek to make his work profitable to him by giving such aid and direction as he may need. Inasmuch as subjects differ greatly, the requirements for all subjects cannot be stated in terms at once specific and uniform. In some departments of knowledge original research may begin with the student's entrance into the School; in other subjects much preliminary work is necessary to fit the student for profitable research.

The branch of knowledge to which the student intends to devote the larger part of his time is termed his major subject. The other fields of study selected, which will be necessarily more restricted in their scope and which should in general be selected with reference to their direct bearing upon the major subject, are termed the minor subjects. Candidates for the Doctor's degree are required to select a major subject and two minor subjects; for the Master's degree, a major subject and one minor subject are required.

In the case of candidates for an advanced degree a statement of the major and minor subjects, approved by the professors with whom the work is taken, must be presented to the Dean not later than two weeks after admission to the Graduate School. In the case of graduate students who are not candidates for an advanced degree a detailed statement of the studies selected must be filed in the Dean's office not later than two weeks after registration. This statement must be endorsed by a member of the Faculty who is selected by the student to act as his adviser.

CANDIDACY FOR AN ADVANCED DEGREE

A student is admitted as a candidate for an advanced degree when he has satisfied the Faculty, and especially the professors with whom he intends to work, that both his general preparation and his preliminary work in his specialty are satisfactory in kind and sufficient in amount. A student who has been admitted to candidacy for an advanced degree will be permitted to take the degree in the minimum time of one year for the Master's degree and three years for the Doctor's degree, provided that the work accomplished during that time is satisfactory.

The conditions for admission to candidacy for an advanced degree are:

(a) The candidate's training must be substantially equivalent to that required for the first degree in one of the four-year courses at this University. Candidates for one of the advanced technical degrees, M.C.E., M.M.E., M.Arch., M.F., M.L.D., and M.S. in Agr., must have had the equivalent of the corresponding first degree at Cornell University.

(b) The candidate must receive the recommendation of his special committee that he is qualified to undertake such advanced work as the Faculty will accept for the degree.

(c) Candidates for the degree of Master in Forestry must also have had at least three months' experience in forestry work or in a logging camp, satisfactory proof of which is to be by a signed statement, or an examination in woodmanship, or both.

SPECIAL COMMITTEES

The work of each candidate for an advanced degree is in charge of a committee consisting of two or more professors under whom his major and minor subjects are pursued, the professor of his major subject being chairman. The student is expected to confer freely with the members of his special committee, not only in connection with individual courses of study but also in regard to the general plan of his work.

THE DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is granted to a student who, after completing not less than three years of resident graduate work, presents a satisfactory thesis, and passes an examination on his major and minor subjects and the subject matter of his thesis. Each candidate for the Doctor's degree must deposit fifty printed copies of his thesis with the Dean for the use of the University Library.

The Doctor's degree is intended to represent not a specified amount of work covering a specified time, but long study and high attainment in a special field, proved in the first place by the presentation of a thesis which displays the power of independent investigation, and in the second place by passing corresponding examinations upon the ground covered by the major and minor subjects chosen at the beginning of the candidacy. The standard for the Doctor's degree is determined by the attainment to be expected of an excellent student, who begins his work with adequate preparation, and devotes his whole time for three years to his major and minor subjects and his thesis.

Candidates for the Doctor's degree will ordinarily be expected to have a working knowledge of French and German before beginning graduate work; and in all cases they must, before beginning their second year of residence, show to the satisfaction of their special committees that they possess a reading knowledge of those languages. If the subjects chosen by the candidate are of such character as to make it desirable that he should be familiar with some foreign language other than French and German, the special committee may, with the consent of the Dean, permit the substitution of that language for one of the two required.

The candidate is required to spend at least three years*, after admission to candidacy, in resident graduate study and investigation of an advanced character.

*In the case of graduate students who at the same time hold appointments as instructors or assistants in Cornell University, the minimum time of residence for a Doctor's degree is four years. Students who are engaged in other outside work which reduces the time and thought that they are able to give to graduate work will also be required to devote more than the minimum time to their study for the Doctor's degree.

Residence as a graduate student in another university may, by permission of the Faculty, be accepted as the equivalent of residence at Cornell University. No general statement can be made regarding the conditions under which this permission will be granted; each case will be decided on its merits. A request for credit for resident work elsewhere must be approved by the student's special committee. At least one year's residence in Cornell University is required in all cases.

Residence for the Master's degree may be credited toward the residence required for the degree of Doctor of Philosophy provided the special committee in charge of the work approves, certifying the work done as suitable for the Doctor's degree.

Examinations for the Doctor's degree will occur during the second week before Commencement, unless another date is set by the Dean. These examinations, which may be either oral or written, or both, at the option of the examining committee, are open to all members of the Faculty. A list giving the dates of the examinations and the members of the examining committees will be issued early in May.

Ordinarily the examination for the Doctor's degree follows the acceptance of the thesis and is held not earlier than the close of the sixth term of residence. If, however, the special committee certifies to the Dean that the candidate has made satisfactory progress on his thesis and that it would be of advantage to have the examination precede the presentation of the thesis, the examination may be held at some date, set by the Dean, not earlier than two weeks before the close of the fifth term of residence. This examination must be followed by an examination on the general subject matter of the thesis at such time as may be designated by the Dean, after the completed thesis has been presented. In any case the completed thesis is to be submitted to all members of the special committee and all participate in the examination on the thesis. In the event of failure in this earlier examination, no re-examination can be held until three months after the completion of the minimum period of residence.

The thesis for the Doctor's degree must be of such character as shall demonstrate the candidate's ability to do original work, and must be satisfactory in style and composition. A statement of the general subject of the thesis, with the written approval of the chairman of the special committee in charge of the candidate's work, must be furnished the Dean at least six months before the date at which the degree is to be taken. The completed thesis, approved by the chairman of the special committee, must be presented to the Dean at least five days before the examination for the degree. This copy may be returned for use at the examination or for binding if time permits.

Each candidate for the Doctor's degree is required to print his thesis and to deposit fifty copies with the Dean for the use of the University Library. The title page must include the statement that the thesis is presented to the Faculty of the Graduate School of Cornell University for the degree of Doctor of Philosophy. The author's name should be given in full, and, if the thesis is a reprint, the place and date of the original publication must be given. If the printing of the thesis is deferred until after Commencement the candidate must deposit a bound typewritten copy with the Dean not later than the Friday preceding Commencement. The size of the page in case of typewritten theses should be

8 x 10½ inches. This copy of the thesis becomes the permanent property of the Library. The diploma for the degree will be withheld until the required number of printed copies has been deposited.

Not all students admitted to the Graduate School may expect to obtain the Doctor's degree at the end of the minimum period of three years. Those whose undergraduate work has been insufficient in amount or too narrowly specialized, as well as those whose preparation in their special field is inadequate, must count upon spending some time—determinable by their proficiency—in work of a character not so advanced as that implied in the minimum residence requirement. The minimum residence requirement of three years applies only to graduates of a four-year course in some college of Cornell University, and to graduates of other institutions who have pursued an equivalent course of study.

THE MASTER'S DEGREE

Cornell University confers the degrees of Master of Arts, Master of Architecture, Master of Civil Engineering, Master of Mechanical Engineering, Master in Forestry, Master in Landscape Design, and Master of Science in Agriculture.

After admission to candidacy for the degree the student must spend at least one year* in residence at this University and pursue, under the direction of his special committee, a course of advanced study including one major and one minor subject.

Each candidate must present a thesis, or essay, as the chairman of his special committee may decide, which shall demonstrate his ability to do independent work, and which shall be acceptable in style and composition. He must then pass an examination on his major and minor subjects and the subject matter of his thesis.

Examinations for the Master's degree will occur during the second week before Commencement, unless another date is set by the Dean. These examinations, which may be written, or oral, or both, at the option of the examining committee, are open to all members of the Faculty. A list giving the dates of the examinations and names of the examining committees will be issued early in May.

A statement of the general subject of the thesis, or essay, with the written approval of the chairman of the special committee in charge of the candidate's work, must be furnished the Dean at least six months before the date at which the degree is to be taken. The completed thesis, or essay, approved by the chairman of the special committee, must be presented to the Dean at least five days before the examination for the degree. This copy may be returned for use at the examination or for binding if time permits.

Each candidate for the Master's degree is required to furnish a bound type-written copy of his thesis, or essay, for the use of the University Library, and this copy is to be delivered to the Dean on or before the Friday preceding Commencement. The size of the page in the case of a typewritten thesis should be 8x10½ inches. This copy of the thesis becomes the permanent property of the Library.

*In the case of graduate students who at the same time hold appointments as instructors or assistants in Cornell University, the minimum time of residence required for a Master's degree is increased by one third. Students who are engaged in other outside work which reduces the time and thought that they are able to give to graduate work will also be required to devote more than the minimum time to their study for the Master's degree.

Not all students admitted to the Graduate School may expect to receive the Master's degree in the minimum time of one year. Those whose undergraduate work has been insufficient in amount, as well as those whose preparation in their special field is inadequate, must expect to spend some time in preparatory work. The minimum residence requirement of one year applies only to students whose preparation at the time of entering the Graduate School is in all respects equivalent to that implied by the corresponding first degree from Cornell University.

FELLOWSHIPS AND GRADUATE SCHOLARSHIPS

The following twenty-five fellowships are annually offered in the Graduate School:

1. The Cornell Fellowship in English.
 2. The McGraw Fellowship in Civil Engineering.
 3. The Sage Fellowship in Chemistry.
 4. The Schuyler Fellowship in Physiology; Vertebrate Zoology, including Anatomy and Histology and Embryology; or Invertebrate Zoology and Entomology.
 5. The Sibley Fellowship in Mechanical and Electrical Engineering.
 6. The Goldwin Smith Fellowship in Botany; Geology; or Physical Geography.
 7. The President White Fellowship in Physics.
 8. The Erastus Brooks Fellowship in Mathematics.
 9. The University Fellowship in Architecture.
 10. The University Fellowship in Romance Languages.
 11. The University Fellowship in German.
 12. The University Fellowship in Agriculture or Veterinary Science.
 13. The University Fellowship in Mechanical and Electrical Engineering.
 14. The President White Fellowship in Modern History.
 15. The President White Fellowship in Political and Social Science.
 - 16-17. The Susan Linn Sage Fellowships in Philosophy.
 18. The Susan Linn Sage Fellowship in Psychology.
 - 19-20. The Fellowships in Political Economy.
 - 21-22. The Fellowships in Greek and Latin.
 23. The Fellowship in American History.
 24. The Jacob Schiff Fellowship in German.
 25. The Edward J. Meyer Memorial Fellowship in Engineering Research.
- The President White Fellowships in Modern History and in Political and Social Science have an annual value of \$600 each; the others have an annual value of \$500 each.

The following seventeen graduate scholarships are annually offered in the Graduate School:

- 1-5. The Susan Linn Sage Graduate Scholarships in Philosophy.
6. The Susan Linn Sage Graduate Scholarship in Psychology.
7. The Graduate Scholarship in Mathematics.
8. The Graduate Scholarship in Chemistry.
9. The Graduate Scholarship in Physics.
10. The Graduate Scholarship in Civil Engineering.

11. The Graduate Scholarship in Latin and Greek.
12. The Graduate Scholarship in Archaeology and Comparative Philology.
13. The Graduate Scholarship in Physiology; Vertebrate Zoology, including Anatomy and Histology and Embryology; or Invertebrate Zoology and Entomology.
14. The Graduate Scholarship in Botany; Geology; or Physical Geography.
15. The Graduate Scholarship in English.
16. The Graduate Scholarship in History.
17. The Graduate Scholarship in Architecture.

The graduate scholarships have an annual value of \$300 each.

All applications for fellowships and graduate scholarships must be made on official forms to be obtained from the Dean of the Graduate School, and must be submitted to him on or before March 15 of the academic year preceding the one for which application is made. Before this application is filed, the applicant should have convinced himself by correspondence with the Dean that he is eligible for admission to the Graduate School of this University in full standing, since appointments are made only to those who are eligible for admission to candidacy for an advanced degree.

All other information, papers, and testimonials should be submitted on or before March 15 to the department in which the applicant desires to carry on the principal part of his work. Applicants are advised to submit any published or unpublished papers or reports showing the result of their study or research which might serve to indicate the extent of their knowledge of the subject matter of their study, or their command of the methods and tools of research, or their capacity generally for clear written expression. Those candidates who are graduates of other colleges or universities should submit recommendations from the instructors best acquainted with their ability and attainments. It should be borne in mind that information cannot be too exact or detailed in the case of students not personally known to the appointing body.

Holders of fellowships and scholarships are charged the same fees as other graduate students.

The term of each fellowship and graduate scholarship is one year; but the term may under exceptional circumstances be extended to two years.

The moneys due on fellowships and graduate scholarships are paid at the office of the Treasurer of the University in six equal payments on October 15th, December 1st, January 15th, February 15th, April 1st, and May 15th.

In view of the fact that practical university instruction will be of use in training fellows and scholars for future usefulness, each holder of a fellowship or graduate scholarship shall be liable to render service to the University in the work of instruction or examination to the extent of four hours a week through the academic year.

All persons elected to fellowships and graduate scholarships are required, upon accepting their appointments, to file a bond that, in case of their resignation before the expiration of the time for which they were appointed, they will repay to the University any sums that they may have received. The bond must be for the value of the fellowship or the scholarship and must have two sureties approved by the Treasurer of the University.

The President White Fellowships in History and Political Science may, in the discretion of the Faculty of the Graduate School, be made travelling fellowships. In the case of a student of very exceptional ability and promise in the fields of either of these fellowships, the two fellowships may, in the discretion of the Faculty, be combined for a single year into one.

The Jacob Schiff Fellowship in German may also, in the discretion of the Faculty of the Graduate School, be made a travelling fellowship.

Honorary Fellowships

Persons upon whom the Doctor's degree has already been conferred may, in the discretion of the Faculty of the Graduate School, be appointed to honorary fellowships. These fellowships cover all fees except laboratory charges. Actual residence at the University and regular registration in the Graduate School are required of appointees.

GRADUATE WORK IN THE SUMMER

Work done in the summer session of Cornell University, under the direction of a member of the Faculty of the Graduate School, may be counted for residence toward the Master's degree under the following conditions: one term's residence to be satisfied by three summer sessions, and two terms' residence by five summer sessions.

It should be noted that in some departments no graduate work is offered in the summer session. A statement of the graduate work offered will be found in the Announcement of the Summer Session, which will be sent on application to the Secretary.

Members of the University Faculty who may so desire have been authorized to offer summer work for graduate students even when such work is entirely separate from the summer session; and students taking such summer work under the personal direction of the member of the committee having charge of the work may, at the discretion of their special committee, be relieved from residence during an equal part of the university year. But no student who offers summer work as above will be recommended for a degree at an earlier date than if all of the work had been done in the regular sessions of the academic year.

The College of Agriculture has just adopted a third term of full length, extending from early in June until late in September, and equivalent to the fall or spring term. The detailed plans for the summer term courses will be completed by March 1, 1914, and may be learned by application to the Secretary of the University.

Students who intend to do graduate work during the summer, except such as are registered in one of the regular Summer Sessions, are required to register at the Dean's office before actually beginning work. Blanks for the purpose may be obtained at the Dean's office.

Under conditions to be ascertained from the Dean, instructors in Cornell University who are at the same time registered in the Graduate School may receive credit for work done without compensation during the summer months away from the University.

FEES

A matriculation fee of \$5 is charged all students on entering the University.

Every student (except those registered in the Medical College in New York City) is charged an Infirmary fee of \$3 a term, payable at the beginning of each term. In return for the Infirmary fee, any sick student is, on his physician's certificate, admitted to the Infirmary, or in the discretion of the Infirmary Committee, to the Ithaca City Hospital, if receivable under its rules. He is given without further charge a bed in a ward, board, and ordinary nursing, for a period not exceeding two weeks in any one academic year. Extra charges are made for private rooms, special foods, and special nurses. If a sick student who has not received two weeks' service in the year is refused admittance to either the Infirmary or the City Hospital, by reason of lack of accommodation, he is entitled to a refund of the fee for both terms.

A graduation fee of \$20 is required of each person about to take an advanced degree. This fee must be paid at least ten days before Commencement. The amount will be refunded should the degree not be conferred.

Every person taking laboratory work or laboratory courses must pay to the Treasurer the fee or the deposit for the materials to be used in the work.

Graduate students who are candidates for an advanced degree are charged tuition (except in the case of the College of Agriculture) at the rate charged in the college in which the major subject is taken. In the case of graduate students who are not candidates for a degree tuition is charged pro rata for each subject taken, the rate in each case being that of the college in which the subject is taught. The tuition charged in the different colleges of the University is as follows:

Medical College	\$150
College of Arts and Sciences	125
College of Law	125
Veterinary College	{ For free tuition } see below
College of Agriculture	
College of Architecture	150
College of Civil Engineering	150
Sibley College	150
Summer Session	30

Tuition is free to New York State students in the State Veterinary College and to graduate students doing their entire work in the State College of Agriculture. For minor subjects taken outside of the College of Agriculture by graduate students whose majors are in Agriculture, pro rata tuition ($\frac{1}{3}$ for each minor) of the college in which the minor is taken will be charged. For minor subjects in the College of Agriculture taken by graduate students whose major subjects are in another college pro rata tuition ($\frac{1}{3}$ for each minor) will be deducted.

Instructors and assistants who are registered in the Graduate School are allowed to take, without the payment of tuition, such work in any college as is approved by their special committees, it being understood that the major subject shall be in the line of work in which they are instructing.

FELLOWS AND GRADUATE SCHOLARS

1913-14

UNIVERSITY FELLOWS

The Cornell Fellowship:

Mary Rebecca Thayer, A.B. (Cornell) 1908; A.M. (same) 1912 English

The McGraw Fellowship:

Roberts John Mann, C.E. (Cornell) 1913 Civil Engineering

The Sage Fellowship:

Gail J. Fink, A.B. (Wabash) 1909 Chemistry

The Schuyler Fellowship:

Dwight Isely, B.A. (Fairmount) 1910; A.M. (Kansas) 1913 Entomology

The Sibley Fellowship:

Frederick George Switzer, M.E. (Cornell) 1913 Mechanical Engineering

The Goldwin Smith Fellowship:

Axel Adolf Olsson, A.B. (Cornell) 1913 Geology

The President White Fellowship:

Carleton Chase Murdock, B.S. (Colgate) 1907; A.M. (Cornell) 1910 Physics

The Erastus Brooks Fellowship:

Anna Helen Tappan, A.B. (Western) 1909; A.M. (Cornell) 1912 Mathematics

John Neal Tilton, jr., B.Arch. (Cornell) 1913 Architecture

Merton Jerome Hubert, A.B. (Cornell) 1913 Romance Languages

Mabel Axey Dominick, A.B. (Cornell) 1910; A.M. (same) 1912 Germanic Languages

J. Shirley Jones, B.S. (California) 1903 Agriculture

Charles Edwin Thomas, M.E. (Cornell) 1913 Mechanical Engineering

*PRESIDENT WHITE FELLOWS IN HISTORY AND POLITICAL SCIENCE

Roy Sherman Stowell, A.B. (Cornell) 1902; A.M. (same) 1903.

Robert Morse Woodbury, A.B. (Clark) 1910; A.M. (same) 1912.

FELLOWS IN POLITICAL ECONOMY

Harold Lyle Reed, A.B. (Oberlin) 1911.

Charles Roland Hugins, A.B. (Cornell) 1911.

FELLOWS IN GREEK AND LATIN

Maud Miriam Sheldon, A.B. (Cornell) 1910.

Elias Root Beadle Willis, A.B. (Pennsylvania) 1901.

FELLOW IN AMERICAN HISTORY

Asa Earl Martin, B.A. (William Jewell) 1908; M.A. (same) 1912.

*To be travelling fellowships for the year 1913-14.

SUSAN LINN SAGE FELLOWS IN PHILOSOPHY

Alma Rosa Thorne, A.B. (Cornell) 1907.

Clyde Monroe Hobart, A.B. (Illinois) 1912; A.M. (same) 1913.

SUSAN LINN SAGE FELLOW IN PSYCHOLOGY

Mabel Ensworth Goudge, B.A. (Dalhousie) 1908; M.A. (same) 1909.

JACOB H. SCHIFF FELLOW IN GERMAN

John Frederick Klein, A.B. (Cornell) 1912; A.M. (same) 1913.

EDWARD J. MEYER MEMORIAL FELLOW IN ENGINEERING RESEARCH

Marshall McKinley Koch, M.E. (Cornell) 1913.

HONORARY FELLOW

George Jackman Sargent, B.S. (New Hampshire) 1909; Ph.D. (Cornell) 1912
Chemistry

SUSAN LINN SAGE SCHOLARS IN PHILOSOPHY

Nann Clark Barr, A.B. (Western) 1911; A.M. (Cornell) 1913.

Henry Arthur Bentson, A.B. (Ottawa) 1913.

Raymond Preston Hawes, A.B. (Brown) 1912; A.M. (same) 1913.

Frank Hyneman Knight, Ph.B. (Milligan) 1911; B.S. (Tennessee) 1913; M.A. (same) 1913.

Anita deLaguna, A.B. (California) 1909.

SUSAN LINN SAGE SCHOLAR IN PSYCHOLOGY

Josephine Nash Curtis, A.B. (Wellesley) 1910; M.A. (same) 1912.

UNIVERSITY GRADUATE SCHOLARS

Jessie Ruth Bahringer, A.B. (Cornell) 1913

Mathematics

Leonard Amby Maynard, A.B. (Wesleyan) 1911

Chemistry

Charles Moon, B.S.C.E. (West Virginia) 1910

Physics

Civil Engineering

Frank Hewitt Cowles, Ph.B. (Wooster) 1907

Latin and Greek

Erma Campbell Lindsay, A.B. (Cornell) 1911; A.M. (same) 1913

Archaeology and Comparative Philology

Reuben Lorenzo Hill, B.S. (Utah Agricultural) 1912

Physiology

Gertrude Elizabeth Douglas, A.B. (Smith) 1904; A.M. (Cornell) 1907

Botany

John William Hebel, A.B. (Indiana) 1912; A.M. (Cornell) 1913

English

Ellen Harrington Adams, A.B. (Cornell) 1913

History

Franklin Pettit, jr., B.Arch. (Cornell) 1913

Architecture

ADVANCED DEGREES

CONFERRED IN 1913

During the year 1913, advanced degrees were conferred as shown in the list below. The title of the thesis is given after the name of each candidate.

Masters of Arts

- Nann Clark Barr, B.A.: The Dualistic Method of Bergson's Philosophy.
Charles Owen Brown, B.S.: Concentration Changes in the Electrolysis of Copper Sulphate Solutions.
Murray Wright Bundy, A.B.: The History of the Words 'Fancy' and 'Imagination' from 1640 to 1712.
Clayton Joseph Buttery, A.B.: The English Influences on Alfred de Vigny.
Laura Turner Cooper, A.B.: Spenser's 'Veue of the Present State of Ireland'; an Introduction with Notes on the First Fifty-five Pages in Grosart's Edition.
Edna Cutter, A.B.: The Use of Ether in the Forcing of Plants.
Malvina Catherine Dahl, A.B.: The Historical Development of Some Ideas in the Analytic Geometry of Space.
Louis Edwin Dallenbach, A.B.: The Comparative Value of Animal Protein and Mineral Nutrient in Feeding Fowls for Egg Production.
Emanuel Ralph Engel, B.A.: Intuition and Intellect in the Philosophy of Bergson.
Jacobus Christian Faure, B.S.: A Study of *Thrips tabaci* Lind., and *Aeolothrips fasciatus* Linn., with Notes on Other Species of *Thysanoptera*.
William Delbert Funkhouser, A.B.: Homologies of the Wing Veins of the *Membracidae*.
Connie Myers Guion, A.B.: Purine Metabolism in the Opossum, Raccoon and Rat.
Bessie Gurnee, A.B.: The Novels of Charles Reade.
Ada May Harrington, A.B.: Materials for a Study of Ruskin's Theory of Poetry.
John William Hebel, A.B.: William Heminge's 'The Fatal Contract,' Edited from the Quartos of 1653, 1661, and 1687.
John Frederick Klein, A.B.: Charles de Costers Légende d'Ulenspiegel und das deutsche Volksbuch von Till Eulenspiegel.
Erma Campbell Lindsay, A.B.: Plautus's Plots.
Arthur William Little, B.A.: Poetical Elements of the Style of Livy in his Second and Third Books.
Ralph Cornelius Lowary, B.Chem.: The Composition of the Gases Produced in Carbohydrate Media of Different Compositions by Sewage and by Intestinal Organisms.
Mary Burdick Lyon, B.A.: The Ecology of the Dragonfly Nymphs of Cascadilla Creek and Miscellaneous Notes on *Odonata*.
Jean Daniel Modell, A.B.: The Vowel Quality of Tonal Sensations.
Alice Ayr Noyes, B.A.: The Biology of the *Net-spinning Trichoptera* of Cascadilla Creek.
Ephraim Laurence Palmer, A.B.: A Seed-Key to Pernicious Weeds of North-eastern United States.

- Emilie Louise Platt, A.B.: The Population of the 'Blanket Algae' of Freshwater Pools.
- Cora Amelia Smith, A.B.: The Development of *Anopheles punctipennis* Say.
- Eunice Stebbins, B.S.: A Study of Edmund Burke's Conception of Fine Art.
- Frances Elvira Worth, B.A.: Paul Heyse's 'Konfessionsnovellen.'

Masters of Science in Agriculture

- Charles Ernest Allred, B.S. in Agr.: Farm Labor.
- Roy David Anthony, B.S., B.S. in Agr.: The Spraying of Fruit.
- David Ely Fink, B.S. in Agr.: The Life History and Biology of the Asparagus Miner (*Agromyza simplex* Loew.) and the Twelve-Spotted Asparagus Beetle (*Crioceris duodecimpunctata* L.).
- Thomas Barksdale Hutcheson, B.S., M.S.: Correlation of Characters in *Avena Sativa*, with Special Reference to Size of Kernels Planted.
- Claude Burton Hutchison, B.S. in Agr.: The Production of Maize.
- Cornelia Ferris Kephart, B.S. in Agr.: The Poison Glands of *Euproctis chrysorrhoea* Linn.
- Halsey B. Knapp, B.S.: Fruits for the Home Garden in New York State.
- Alexander McTaggart, B.S.A.: A Study of Plateation in the *Aster cordifolius* Linn.
- Hiralal Hargovind Pandya, L.Ag.: A Study of Agricultural Methods in America with a View to Their Possible Application in India.
- Byron Burnett Robb, B.S. in Agr.: An Experiment in the Irrigation of Peach Trees.
- Wayne Heebner Rothenberger, B.S. in Agr.: The Influences of Cities on Types of Farming.
- James Lewis Strahan, B.S. in Agr.: An Experiment in the Irrigation of Peach Trees.
- William Orr Whitcomb, B.S.A.: Studies of Correlation in Barley (*Hordeum sativa*).
- Paul Work, A.B., B.Sc.: Vegetable Production on the South Lima Area of Muck Land.

Master in Forestry

- Jay P. Kinney, A.B., LL.B.: Colonial and Federal Forest Legislation in America.

Masters in Landscape Design

- Claude Ellsworth Mitchell, B.S.: A Preliminary Plan and Report on Suggested Improvement and Extension for the Village of Rose, New York.
- John Raymond Van Kleek, B.S.: A Preliminary Study and Report Relative to the Civic Betterment of Auburn, New York.

Master of Architecture

- Charles Lewis Bowman, B. Arch.: (No thesis required).

Masters of Civil Engineering

- Francis Murray Dawson, B.Sc. in C.E.: The Influence of Upstream Vertical Curvature on Weir Discharge.

José Páez, C.E.: A Comparative and Critical Study of the Different Methods of Computing Secondary Stresses in Bridge Trusses.

Masters of Mechanical Engineering

John Randolph DuPriest, B.S. in E.E., M.E.: A Problem in Gas Engine Design with Special Reference to Regulation.

Charles Wallace Hunt, M.E.: Heat Transmission in Poor Conductors.

Nathan Clarke Johnson, M.E.: The Hydration of Portland Cement Mortars.

Myron A. Lee, M.E.: Heating and Ventilating (An Experimental Investigation).

Preston Littlepage Peach, M.E.: The Effect of Compression upon the Mechanical Efficiency and Consumption of the Steam Engine.

Doctors of Philosophy

Edward Riley Allen, B.S.: The Orcinolpthaleins, the Orcinoltetrachlorophthaleins, and Some of their Derivatives.

Adeline Sarah Ames, B.Sc., A.M.: Studies in the Polyporaceae.

Hiram Douthitt Ayres, B.Sc., A.M.: The Refraction of Gases at Different Temperatures and Pressures.

Richard Rutherford Blews, A.B.: The Roman Law of Heraclea.

Thomas Roland Briggs, A.B.: The Electrochemical Production of Colloidal Copper.

Henry John Broderson, B.A., M.A.: Solubilities and Chemical Reactions in Anhydrous Hydrazine.

Karl M. Dallenbach, A.B., M.A.: The Measurement of Attention.

Maxwell Jay Dorsey, B.S., M.S. in Agr.: Pollen Development in *Vitis* with Special Reference to Sterility.

Alfred Washington Drinkard, jr., B.S., M.S.: Heredity and Variation in *Browallia*.

Harry Morton Fitzpatrick, A.B.: A Comparative Study of the Development of the Fruit Body in *Phallogaster*, *Hysterangium*, and *Gautieria*.

William Silliman Foster, A.B.: On the Preservative Tendency.

Howard Brett Frost, B.S. in Agr.: M.S. in Agr.: The Relation of Temperature to Variation in *Matthiola*.

Margaret Graham, A.B., A. M.: Studies in Nuclear Division of *Preissia commutata*.

Edward Sewall Guthrie, B.S.A.; M.S. in Agr.: The Metallic Flavor in Dairy Products.

Bascombe Britt Higgins, B.S., M.S.: A Contribution to the Life History and Physiology of *Cylindrosporium* on Stone Fruits.

Arthur Romaine Hitch, A.B., M.S.: The Electrolytic and Thermal Decomposition of Some Inorganic Trinitrates.

Earle Hesse Kennard, B.A.: The Rate of Decay of Phosphorescence at Low Temperatures.

George Albright Land, A.B.: The Agreement of the Verb with Its Subject in Early Latin.

Burton Judson Lemon, A.B.: The Electrolysis of Solutions of the Rare Earths.

James Martin Lohr, A.B.: The Tensile Strengths of the Copper Zinc Alloys.

Lawrence Martin, A.B.: Some Features of the Glaciers and Glaciation in College Fiord, Prince William Sound, Alaska.

- Tanomo Odaira, B.S. in Agr.: A Study of Heredity and Variation in Pure Lines and in Hybrids of *Phaseolus vulgaris*.
- Martin John Prucha, Ph.B., M.S.: Can the Efficiency of *Bacillus radicola* in Producing Nodules on the Legumes be Altered?
- Harold Eaton Riegger, A.B.: Hydronitric Acid and Hydrazine Trinitride.
- Fred M. Rolfs, B.S., M.S.: A Bacterial Disease of the Stone Fruits Due to *Bacterium pruni*, E. F. S.
- Christian Alban Ruckmich, B.A., M.A.: The Rôle of Kinaesthesia in the Perception of Rhythm.
- Benjamin Franklin Stelter, A.B., M.A.: Ælfric's Old English 'Genesis'.
- Vern Bonham Stewart, B.A.: The Fire Blight Disease in Nursery Stock.
- Roland Elisha Stone, B.Sc., M.Sc.: The Life History of *Ascochyta* of Some Leguminous Plants.
- Hawley Otis Taylor, A.B.: A Direct Method of Finding the Value of Materials as Sound Absorbers.
- George Ellsworth Thompson, A.B., A.M.: An Experimental Study of Photo-active Cells with Fluorescent Electrolytes.
- Harvey Gates Townsend, B.A.: The Concept of Individuality in the Philosophy of Thomas Hill Green.
- Lawrence J. Ulrich, A.B.: Equilibrium in Certain Binary Systems.
- Eleanor Van Ness Van Alstyne, B.S.: The Absorption of Protein without Digestion.
- Thomas Whitney Benson Welsh, A.B.: Contributions to the Chemistry of Hydrazine.

UNIVERSITY LIBRARIES

G. W. HARRIS, Librarian; A. C. WHITE, Assistant Librarian, in charge of Classification; W. H. AUSTEN, Assistant Librarian, in charge of the Reference Library; G. L. BURR, Librarian of the President White Library; E. E. WILLEVER, Librarian of the Law Library; A. J. LAMOUREUX, Librarian of the Agricultural Library; H. HERMANSSON, in charge of the Icelandic Collection; Miss M. FOWLER, in charge of the Petrarch and Dante Collections.

The University Libraries comprise the General Library of the University, the eight Seminary Libraries, the Law Library, the Flower Veterinary Library, the Barnes Reference Library, the Goldwin Smith Hall Library, the Stimson Hall Medical Library, and the Library of the New York State College of Agriculture. The total number of bound volumes in them is now about four hundred and thirty thousand and is increasing at the rate of about thirteen thousand volumes a year. The number of periodicals, transactions, and other serials, currently received, is over two thousand, and of most of these complete sets are on the shelves. The General Library of the University and the seven Seminary Libraries are all grouped under one roof in the Library Building, while the remaining collections are to be found in the buildings devoted to their respective subjects.

Among the more important special collections in the General Library may be mentioned: THE ANTHON LIBRARY, of nearly seven thousand volumes, the collection made by the late Professor Charles Anthon, of Columbia College, in the ancient classical languages and literatures, besides works in history and general literature; THE BOPP LIBRARY, of about twenty-five hundred volumes, relating to the oriental languages and literatures, and comparative philology, being the collection of the late Professor Franz Bopp of the University of Berlin; THE GOLDWIN SMITH LIBRARY, of thirty-five hundred volumes, comprising chiefly historical works and editions of the English and ancient classics, presented to the University in 1869 by the late Professor Goldwin Smith, and increased during later years by the continued liberality of the donor; THE PUBLICATIONS of the Patent Office of Great Britain, about three thousand volumes; THE WHITE ARCHITECTURAL LIBRARY, a collection of over twelve hundred volumes relating to architecture and kindred branches of science, given by ex-President White; THE KELLY MATHEMATICAL LIBRARY, comprising eighteen hundred volumes and seven hundred tracts, presented by the late Hon. William Kelly, of Rhinebeck; THE SPARKS LIBRARY, being the library of Jared Sparks, sometime President of Harvard University, consisting of upward of five thousand volumes and four thousand pamphlets, relating chiefly to the history of America; THE MAY COLLECTION, relating to the history of slavery and anti-slavery, the nucleus of which was formed by the gift of the library of the late Rev. Samuel J. May, of Syracuse; THE SCHUYLER COLLECTION of folk-lore, Russian history and literature, presented by the late Hon. Eugene Schuyler in 1884; THE PRESIDENT WHITE HISTORICAL LIBRARY, of about twenty thousand volumes (including bound collections of pamphlets) and some three thousand unbound pamphlets, the gift of ex-President White, received in 1891, especially rich in the primary sources of history, and containing notable collections on the period of the Reforma-

tion, on the English and French Revolutions, on the American Civil War, and on the history of superstition; THE SPINOZA COLLECTION, numbering four hundred and fifty volumes, presented in 1894, by ex-President White; the four remarkably rich collections given by the late Willard Fiske, comprising the DANTE COLLECTION, containing seven thousand five hundred volumes, the PETRARCH COLLECTION, containing about four thousand volumes, the RHAETO-ROMANIC COLLECTION, containing about thirteen hundred volumes, and the ICELANDIC COLLECTION, containing over ten thousand volumes; THE ZARNCKE LIBRARY, containing about thirteen thousand volumes and pamphlets, especially rich in Germanic philology and literature, purchased and presented in 1893 by William H. Sage; THE HERBERT H. SMITH COLLECTION of books relating to South America, purchased in 1896; a valuable collection of books on French and Italian society in the 16th and 17th centuries, presented by Professor T. F. Crane in 1896; THE FLOWER VETERINARY LIBRARY, the gift of ex-Governor Flower to Cornell University, for the use of the State Veterinary College in 1897; THE EISENLOHR LIBRARY, containing about one thousand volumes on Egyptology and Assyriology purchased and presented in 1902 by A. Abraham; BAYARD TAYLOR's correspondence and journals and his collection of Goethe literature, presented to the Library in 1905 by Mrs. Marie Taylor; the valuable ANGLO-SAXON COLLECTION and the COWPER COLLECTION formed by the late Professor Hiram Corson, bequeathed to the Library, and received in 1911.

THE LAW LIBRARY of forty-five thousand volumes contains an unusually complete collection of American, English, and Colonial reports, with complement of textbooks and statutes, and complete sets of all the leading law periodicals in English.

These collections and others such as these, making possible an exhaustive study of certain fields, are of the greatest service in training in research. A similar purpose is served by the seminary rooms of the University Library. Thus, for the study of English, of the classical languages, of the Germanic and Romance languages, of philosophy, of politics and economics, of American and of European history, there have been provided in the library building seven of these research rooms, each equipped with a carefully chosen body of reference books, to which advanced students in these fields have access. In connection with the scientific and technical laboratories similar collections have been formed, well supplied with reference books, standard works, and sets of periodicals, conveniently arranged for study and research.

Cards of admission to the shelves in the stackrooms and to the White Historical Library will be issued by the Librarian to graduate students for the purpose of consultation and research. Though the Library is primarily a reference library, the privilege of taking books for home use is granted to all students who comply with the library regulations.

FURTHER FACILITIES FOR GRADUATE STUDY AND COURSES OF INSTRUCTION

The courses outlined in the following pages are grouped primarily on the basis of subject matter. Under each subject there is usually given, in a separate paragraph, a list of courses which are too elementary in character to be likely to interest graduate students of that subject. There then follows a list of all those courses which, whether open or not open to undergraduates, are deemed likely to be of profit to graduate students.

More detailed information concerning any one of these various courses (time and place of meeting, and, in the case of a few courses given in alternate years, whether or not offered in 1914-15, etc.) will be found in the separate announcement of the college in which the particular course is given. The last edition of these special announcements of the various colleges may be obtained gratis and post-free on application to the Secretary of the University.

SEMITIC LANGUAGES AND LITERATURES

Professor: NATHANIEL SCHMIDT.

Special facilities for advanced work in this subject are: 1. a collection of several hundred squeezes of inscriptions found in Syria and Arabia Petraea, chiefly in Arabic, Hebrew, Syriac, Assyrian, Nabataean, and Greek; 2. squeezes of Old Egyptian, Coptic, and Hittite inscriptions; 3. a collection of several thousand photographs taken in Syria and Arabia Petraea, and slides taken from these photographs; 4. reproductions of inscriptions and objects of art in the Museum of Casts; 5. a valuable collection of Arabic, Hebrew, Samaritan, Ethiopic, and Coptic manuscripts secured in Syria; 6. the Eisenlohr Library, especially rich in Egyptology; 7. the Fiske collection of Arabic books; 8. a growing collection of Egyptian antiquities.

To the candidate for an advanced degree, opportunities are offered of studying every Semitic language and dialect, and also Sumerian, Old Egyptian, and Coptic. The student may, if he so chooses, specialize in Semitic literature or in Oriental history. A candidate for the Master's degree or the Doctor's degree, with Semitic languages as a major subject, must have had a year of elementary Hebrew or Arabic; and a candidate for either of these degrees, with Oriental history as a major subject, must have had one year of ancient history and one year either of the history of Asia or the history of Africa, before entering upon the graduate course.

Advanced Hebrew.

Neo-Hebraic.

Ethiopic.

Assyrian.

Sumerian.

Aramaic (Mandaic, Babylonian Talmudic, Syriac, Nabataean, Palmyrene, Galilaean, Samaritan, and Judaeae).

Arabic (Sabaean and Minaean, Classical, Modern).

Egyptian.

Coptic.

Comparative Semitic Philology.

Semitic Epigraphy (in Semitic Seminary).

Hebrew Literature (in Semitic Seminary).

The History of Asia.

The History of Africa.

The Sources of Oriental History (in Historical Seminary).

GREEK

Professors: J. R. S. STERRETT; G. P. BRISTOL; H. L. JONES.

Reader: A. C. WHITE.

The general library and the special library of over two thousand volumes in the seminary rooms afford ample facilities for graduate work. The special library is rich in complete sets of philological and archaeological periodicals in various languages, and contains all the standard works that form the laboratory apparatus of the graduate student. Other books will be transferred from the general library to the seminary rooms as they are needed.

In general, the student who wishes to do graduate work in Greek should have pursued classical studies (Greek, Latin, and kindred topics) systematically to the end of his senior year in college. The ability to read German is necessary, and the ability to read French is greatly to be desired.

Elementary Greek; Plato's Dialogues, Homer's Odyssey; Lysias; Herodotus; Greek Composition; Euripides, the Iphigenia in Tauris and the Medea; Sophocles, the Oedipus Tyrannus and the Antigone; the Iliad or Plato, Protagoras and Phaedrus; Plato, Demosthenes, On the Crown.

Theocritus, Bion, Moschus, and Herondas. Professor STERRETT.

Aristophanes, Birds and Clouds. Professor STERRETT.

New Testament. Dr. WHITE.

Greek Life. Professor STERRETT.

Myths of the Epic Cycle. Assistant Professor JONES.

Advanced Greek Composition. Assistant Professor JONES.

History of Greek Poetical Literature. Professor STERRETT.

History of Greek Prose Literature. Professor STERRETT.

Rapid Reading of the Tragedies of Sophocles and Euripides, in alternate years.

Professor STERRETT.

The Critical Study and Interpretation of the Agamemnon of Aeschylus.

Professor STERRETT.

Pindar. Professor STERRETT.

Aristophanes. Study of the Structure and Composition of all the Comedies, every third year. Professor STERRETT.

The Republic of Plato. Assistant Professor JONES.

The Dialect of Homer. Professor STERRETT.

Greek Seminary. Professor STERRETT.

GREEK ART AND ANTIQUITIES

Professor: E. P. ANDREWS.

The Museum of Casts furnishes abundant material for the study of Greek sculpture and for most branches of Greek archaeology. Several hundred squeezes bring the most important Greek inscriptions within reach for independent work in Greek epigraphy. The University Library contains complete sets of the most important archaeological periodicals.

Ability to read French and German, as well as Greek and Latin, is assumed.

A scholarship in archaeology and comparative philology is awarded annually.

History of Greek Sculpture; Greek Archaeology.

Pausanias.

Modern Greek.

Greek Epigraphy, in Seminary.

Greek Archaeology, in Seminary.

History of Greek Sculpture.

LATIN

Professors: C. E. BENNETT; H. C. ELMER; C. L. DURHAM.

Graduate students in Latin have the use of the Latin seminary, consisting of two rooms in the University Library. The seminary contains several thousand volumes of texts and other works of reference, including complete sets of all the journals of classical philology. Two Greek and Latin fellowships and one scholarship are annually awarded.

Elementary Latin; Livy, Cicero, Horace; Sight Translation; Virgil's Aeneid, Books I-VI; Latin Conversation and Oral Composition; Terence, Horace, Tacitus; Sight Translation for sophomores; Catullus, Virgil, Ovid, Martial; Classic Myths in English Literature; Cicero's Letters, Cicero de Oratore, Book I; Cicero's De Officiis, Cicero's Second Philippic; Plautus, Lucretius, Lectures on the History of Roman Literature; Suetonius, Pliny, Tacitus; Intermediate Course in Latin Writing; Teachers' Training Course; Roman Private and Political Antiquities; Cicero in Verrem; Virgil's Aeneid, Books VII-XII.

Latin Seminary. Professor BENNETT.

History, Aim, and Scope of Latin Studies. Professor BENNETT.

Historical Latin Syntax. Professor BENNETT.

Historical Grammar of the Latin Language. Professor BENNETT.

Latin Writing, Advanced Course. Professor ELMER.

History and Development of Roman Epic Poetry. Professor ELMER.

Vulgar Latin. Professor DURHAM.

Latin Epigraphy. Professor DURHAM.

Carmina Latina Epigraphica. Professor DURHAM.

GERMAN

Professors: A. B. FAUST; P. R. POPE; H. C. DAVIDSEN; A. W. BOESCHE.
 Instructors: A. L. ANDREWS; W. D. ZINNECKER.

In the advanced courses in this subject, the work is twofold, literary and philological. The history of German literature from the earliest period to the present day is given in outline lecture courses with collateral reading. Special topics are selected for more minute study, such as the epic and lyrical poetry of the Middle High German period, the literature of the Reformation, the classical period, the romantic school, the modern drama. The courses offered in philology include the study of Gothic, Old and Middle High German, and Old Norse. They afford also an introduction to the science of language and the principles of phonetics.

The seminars in German literature and philology aim to impart the principles and methods of investigation. A teachers' course deals with class-room methods and theories of instruction in the modern languages.

All the work in German is greatly facilitated by an exceptional library equipment. The nucleus was formed by the acquisition of the Zarncke library, one of the largest collections of rare books for the study of German literature and philology ever brought to America. With constant enlargements the library has become one of the most serviceable in the country. The University Library also contains the Willard Fiske collection of books on Icelandic literature, one of the most complete in existence. The German seminary room in the University Library contains books for ready reference, including philological journals and reviews.

Candidates for advanced degrees in German are expected to have an adequate knowledge of French and Latin. Two fellowships in German are awarded annually.

Elementary German; Second, and Third German Course; Elementary German Composition and Conversation; Advanced German Composition and Conversation; Intermediate German Course; Reading Course; Rapid Reading Course.

Schiller's Life and Works. Assistant Professor BOESCHE.

Goethe. Professor FAUST.

Goethe's Faust. Professor FAUST.

History of German Literature. Professor FAUST.

The German Drama of the Nineteenth Century. Assistant Professor DAVIDSEN.

The Literature of the Reformation. Assistant Professor DAVIDSEN.

Lessing. Assistant Professor DAVIDSEN.

The Romantic Movement in Germany. Assistant Professor BOESCHE.

Friedrich Hebbel. Assistant Professor DAVIDSEN.

Henrik Ibsen. Assistant Professor DAVIDSEN.

Richard Wagner, His Life and Works. Assistant Professor POPE.

German Lyrics and Ballads. Assistant Professor POPE.

Sturm und Drang. Assistant Professor BOESCHE.

Studies in German Style. Assistant Professor DAVIDSEN.

The History of the German Element in the United States. Professor FAUST.

Scientific German. Assistant Professor BOESCHE.

Elementary Phonetics and its Application to the Study of Modern Languages.

Assistant Professor DAVIDSEN.

Principles of Word-Formation. Assistant Professor DAVIDSEN.

Topics in Historical German Syntax. Assistant Professor BOESCHE.

Elementary Middle High German. Professor POPE.

Advanced Middle High German. Professor POPE.

Modern Scandinavian. Dr. ANDREWS.

Gothic. Assistant Professor BOESCHE.

Old High German. Assistant Professor BOESCHE.

Old Saxon. Assistant Professor POPE.

Principles of Germanic Philology. Dr. ANDREWS.

Old Icelandic. Dr. ANDREWS.

History of Modern High German. Dr. ANDREWS.

Teachers' Course. Professor FAUST, with aid from his colleagues.

Seminary in German Literature. Professor FAUST and Assistant Professor DAVIDSEN.

Seminary in Germanic Philology. Assistant Professors POPE and BOESCHE.

Introduction to the Study of Language. Professor BRISTOL.

The History of German Art. Professor A. WEESE, Professor of the History of Art, University of Bern, Jacob H. Schiff non-resident lecturer, 1915.

ROMANCE LANGUAGES AND LITERATURES

Professors: W. W. COMFORT; E. W. OLMSTED; O. G. GUERLAC; G. L. HAMILTON; J. F. MASON.

Instructors: L. PUMPELLY; G. I. DALE; G. H. BROWN.

The collection of French books in the University Library is very large, and offers excellent facilities for advanced work. The Spanish library, though in large measure recently acquired, is quite representative. Objects of special pride are the unrivalled Dante and Petrarch collections, the gift of the late Willard Fiske, who likewise presented to the University a unique collection of Rhaeto-Romance works. Smaller collections of Portuguese and Provençal books are also to be found in the University Library. The seminary library contains several thousand volumes including many sets of bound periodicals. A university fellowship (of the value of \$500) in Romance languages is annually awarded.

The courses of study in this department are divided into three categories: those intended primarily for undergraduates, those intended alike for undergraduates and graduates, and those intended primarily for graduates. All candidates for advanced degrees in this department must possess a thorough reading knowledge of Latin, French, and German before announcing their candidacy.

A candidate for the degree of Master of Arts whose major subject is in Romance languages is expected to present for the approval of the chairman of his special committee, within two weeks after registration day, an outline of the work planned for the year. The thesis must, before May 1st, be submitted for the criticism of the chairman of the candidate's special committee. If not already taken, the course in French philology is required of graduate students in their first year of study.

Candidates for the degree of Doctor of Philosophy are expected to follow advanced courses given in the branch in which their major subject lies, and to take up such work as will give a comprehensive view of the branches in which their minor subjects lie. It is intended that the last year of preparation for this degree shall be spent chiefly upon the thesis. Further information may be obtained from the professors in this department.

NOTE.—No distinction will be made between language and literature in reckoning major and minor subjects. Thus, French language and literature counts as only one subject.

First Year French; Second Year French; Third Year French; Fourth Year French; Elementary French Conversation and Composition; First Year Italian; First Year Spanish.

History of French Literature. Professor COMFORT and Assistant Professor GUERLAC.

French Literature of the Sixteenth Century. Assistant Professor MASON.

French Literature of the Seventeenth Century. Professor COMFORT.

French Literature of the Eighteenth Century. Assistant Professor GUERLAC.

French Literature of the Nineteenth Century. Assistant Professor MASON.

French Dramatic Literature. Professor OLMSTED.

French Fiction. Professor OLMSTED.

French Lyric Poetry. Professor OLMSTED.

Medieval French Literature. Professor COMFORT.

Advanced French Conversation and Composition. Assistant Professor GUERLAC.

French Phonetics. Dr. PUMPELLY.

French Philology. Dr. PUMPELLY.

Modern French Literature Seminary. Assistant Professor MASON.

Second Year Italian. Assistant Professor HAMILTON.

Petrarch and Modern Poetry. Assistant Professor HAMILTON.

Boccaccio and Modern Prose. Assistant Professor HAMILTON.

Dante and the Middle Ages. Assistant Professor HAMILTON.

Second Year Spanish. Mr. DALE.

Spanish Classical Literature. Professor OLMSTED.

Low Latin. Assistant Professor HAMILTON.

Comparative Romance Philology. Assistant Professor HAMILTON.

Old French Texts. Professor COMFORT.

Old French Phonology and Morphology. Assistant Professor HAMILTON.

Old Spanish. Professor OLMSTED.

Spanish Seminary. Professor OLMSTED.

Portuguese Grammar and Reading. Professor OLMSTED.

Old Provençal. Assistant Professor HAMILTON.

ENGLISH

Professors: M. W. SAMPSON; W. STRUNK, JR.; F. C. PRESCOTT; C. S. NORTHUP;
LANE COOPER; J. Q. ADAMS, JR.; B. S. MONROE.

Instructors: E. J. BAILEY; R. R. KIRK; F. M. SMITH; L. N. BROUGHTON;
B. F. STELTER; D. L. BALDWIN; A. H. GILBERT; M. G. CROWELL; G. E.
JENSEN; JOHN TOWNLEY.

Among the books available to the student are complete sets of the publications of the Early English Text, Chaucer, Scottish Text, Percy, English Dialect, Shakespeare, New Shakspeare, Spenser, Philological, Malone, and other societies; of the Arber, Bullen, and Grosart reprints; and of the important periodicals dealing with the English language and literature. Most of the foreign dissertations on English subjects, standard and other editions of individual authors, English and American, and several special collections, are also in the Library, which is exceptionally good in the field of Old English, and in the Elizabethan and Victorian periods. The department has a seminary room in the University Library. A fellowship and a scholarship are annually awarded.

Candidates for an advanced degree may take their major subject in literature or in language. In general, thirty-six hours (i. e., three full years) of college English are required before a student may enter upon candidacy for an advanced degree. Work in philosophy, history, and languages, ancient and modern, may at the discretion of the candidate's special committee, be counted against a shortage in undergraduate English. Training in the Greek and Latin literatures is especially desirable as a preparation for graduate work in English. All candidates must complete a satisfactory amount of work in Old English; must have a general knowledge of English literature and English history; and must accomplish satisfactory work in research. Candidates for the Master's degree must have sufficient knowledge of French or German to make use of scholarly works in one of those languages, and candidates for the Doctor's degree must have a similar knowledge of both French and German, and a knowledge of Latin.

Introductory Course; English Poetry and Prose; Nineteenth Century Prose; Advanced Composition; Teachers' Course; Play Writing; Nineteenth Century Poetry; Greek and Latin Classics in Translation; Eighteenth Century Poetry; Poetry and Versification.

Old English. Assistant Professor MONROE.

Chaucer and his Contemporaries. Professor STRUNK.

Spenser and Milton. Dr. BAILEY.

Shakespeare. Professor STRUNK.

The English Drama to 1642. Assistant Professor ADAMS.

Lyric Poetry. Dr. STELTER.

Milton and the Epic. Dr. GILBERT.

Eighteenth Century Fiction. Dr. JENSEN.

Dante in English. Assistant Professor COOPER.

Victorian Literature. Assistant Professor NORTHUP.

Methods and Materials of English Study. Assistant Professor COOPER.

The Epic and the Romance. Assistant Professor NORTHUP.

Dramatic Structure. Professor SAMPSON.

Non-dramatic Elizabethan Literature. Assistant Professor ADAMS.

The Arthurian Legends. Assistant Professor NORTHUP.

Layamon's Brut. Assistant Professor MONROE.

Pastoral Poetry. Dr. BROUGHTON.

Principles of Criticism. Assistant Professor COOPER.

Relations of English and American Literature. Assistant Professor PRESCOTT.

In addition to directing research beyond the limits of the courses listed above, the members of the instructing staff will supervise original work, either in seminars or by individual conferences, in the fields here noted:

Middle English. Assistant Professor MONROE.

The Tudor-Stuart Drama. Assistant Professor ADAMS.

The Earlier Literature of the Nineteenth Century. Assistant Professor COOPER.

Middle English Literature. Assistant Professor NORTHUP.

American Literature. Assistant Professor PRESCOTT.

English Philology. Professor STRUNK.

Theory of the Drama. Professor SAMPSON.

PHILOSOPHY AND PSYCHOLOGY

The subjects of philosophy and psychology are grouped in The Susan Linn Sage School of Philosophy. This school owes its existence to the generosity of the late Henry W. Sage, who, in addition to endowing the Susan Linn Sage philosophical professorship, made a further gift of \$200,000, for the purpose of providing permanently at Cornell University for philosophical instruction and investigation of the most varied kind and of the highest order. The endowments of the School of Philosophy enable it to secure whatever material facilities are required for the successful prosecution of philosophical studies and research. The more important philosophical and psychological journals, American and foreign, are received by the Library, which is also well equipped with philosophical and psychological works, and is particularly rich in literature relating to Plato, Spinoza, and Kant.

The larger part of the work of the Sage School is adapted to the needs of graduates of this and other institutions who are preparing themselves to be teachers or investigators in philosophy and in allied fields of study. A student who has made a special study of philosophy during his junior and senior years may still take a graduate course of three years' work with history of philosophy, logic and metaphysics, ethics, or psychology, as his major subject. For the encouragement of higher studies and research in every branch represented by the School of Philosophy, there have been established three fellowships of the annual value of \$500 each, and six scholarships of the annual value of \$300 each. Of these, one fellowship and one scholarship are regularly assigned to psychology. Applicants for fellowships and scholarships should therefore state definitely whether their major subject will be in one of the several branches of philosophy or in psychology.

The School is devoted to the free and unhampered investigation of truth in regard to all those questions of human inquiry which are embraced by logic,

metaphysics, psychology, ethics, and the history and philosophy of religion. In the courses of instruction are represented the chief branches and problems of philosophy. Work devoted to the thesis for the doctorate is intended to secure the maximum of specialized training and the power of independent inquiry and statement of results. In all divisions of philosophy particular stress is laid upon the historical study of philosophical ideas as the best means of securing a comprehensive grasp of fundamental problems and values.

Philosophy

Professors: J. E. CREIGHTON, Logic and Metaphysics; FRANK THILLY, Philosophy; W. A. HAMMOND, Ancient and Medieval Philosophy; ERNEST ALBEE, Philosophy.

Instructor: W. K. WRIGHT, Philosophy.

The philosophical seminary room in the University Library is provided with complete sets of the leading philosophical journals, lexicons, and other books of reference, and the more important works in the several branches of philosophy and psychology. The current numbers of the philosophical journals are also to be found in the room. Liberal provision is made for the constant growth of this special library.

The Philosophical Review, established by the University, is a bi-monthly journal devoted to the interests of philosophy, embracing under that title logic, metaphysics, ethics, psychology, æsthetics, and philosophy of religion. Although supported by private endowment, it is not the organ of any institution or of any philosophical school, but by the terms of the subsidy is an absolutely free organ of contemporary philosophy. Graduate students assist by contributing summaries of periodical literature for publication in the Review, and are thus kept in close touch with the results of recent investigations in their several departments of work. In addition to this, graduate students have from time to time contributed a number of original articles to the Review.

Under the title of Cornell Studies in Philosophy, a series of monograph studies is published from time to time as representative of the work done by graduate students in philosophy. These monographs are issued under the editorial supervision of the professors of philosophy, and consist mainly of doctoral dissertations of high quality. The series furnishes also a channel for the publication of research other than that of the thesis. Nine monographs have been issued in the series.

A full description of the courses given by the Department of Philosophy will be found in the Announcement of the College of Arts and Sciences. While any of these courses may be utilized by graduates, attendance at lectures does not constitute graduate work. The following courses are more especially arranged with reference to the needs of graduate students.

History of Philosophy. Professor CREIGHTON.

Rapid Reading of German Philosophy. Professor HAMMOND.

History of Ancient and Medieval Philosophy. Professor HAMMOND.

Types of Metaphysical Theory. Professor CREIGHTON.

Philosophical Applications and Results. Professor CREIGHTON.

History of Ethics, Ancient, Medieval, and Renaissance. Professor HAMMOND.

- History of Modern Ethics. Professor ALBEE.
 Social and Political Ethics. Professor THILLY.
 Contemporary Theories of Ethics. Professor THILLY.
 The Republic of Plato, Greek text. Professor HAMMOND.
 Aristotle's Ethics, Greek text. Professor HAMMOND.
 Thomas Aquinas. Professor HAMMOND.
 Empiricism and Rationalism in the Seventeenth and Eighteenth Centuries.
 Professor ALBEE.
 The Critical Philosophy of Kant. Professor ALBEE.
 Early Rationalism: Spinoza and Leibniz. Professor ALBEE.
 German Pessimism, with special reference to Schopenhauer. Professor
 ALBEE.
 Problems and Methods in Recent Philosophy. Professor ALBEE.
 Logical Theory: A Study of Bradley, Bosanquet, Dewey, and others. Pro-
 fessor ALBEE.
 Fundamental Ethical Concepts. Professor THILLY.
 Seminary in Ethics. Professor THILLY.
 Seminary in Logic and Metaphysics. Professor CREIGHTON.
 Seminary in Ancient and Medieval Philosophy. Professor HAMMOND.

Psychology

Professors: E. B. TITCHENER; H. P. WELD.

Instructors: W. S. FOSTER; E. G. BORING.

The research department of the psychological laboratory in Morrill Hall contains fifteen rooms, two of which are used as the private laboratories of the officers of instruction, one as a seminary room, and one as a workshop; the remainder are at the disposal of students for advanced work. The experimental rooms are furnished, as required, with gas, water, and the direct and alternating electric current; they are also connected by an elaborate wiring system, so that two or more rooms may be employed together in a single investigation. There are two dark chambers. The workshop is adequately equipped, and a skilled mechanic is in the service of the department. The laboratory possesses standard instruments of precision for all the principal modes of experiment upon human consciousness, and is especially rich on the side of acoustics. Materials are available, or can be supplied, for the study of certain problems in comparative psychology. The equipment is undergoing continual improvement, and special apparatus required for research is at once constructed or procured. The results of investigations pursued in the laboratory are published in the American Journal of Psychology.

Graduate students further have the use of the unusually complete sets of demonstrational and teaching apparatus contained in the demonstrational laboratory (Goldwin Smith Hall) and the undergraduate laboratory (Morrill Hall).

Elementary Psychology. Professor TITCHENER.

Experimental Psychology, Qualitative and Quantitative. Assistant Professor WELD, Dr. FOSTER, Messrs. BORING and BISHOP.

General Psychology: Problems and Points of View. Assistant Professor WELD.

Systematic Psychology. Assistant Professor WELD and Dr. FOSTER.

Reading of German Psychology. Mr. BORING.

Reading of French Psychology. Mr. BORING.

Apparatus and Methods: Technique of the Laboratory. Dr. FOSTER.

Psychological Problems, Historical and Experimental. Assistant Professor WELD, Dr. FOSTER and Mr. BORING.

Research Laboratory. Professor TITCHENER.

EDUCATION

Professors: —; G. M. WHIPPLE.

The educational museum contains collections illustrating the work done in various school grades, statistical charts, a full assortment of textbooks for American and German schools, including a relatively complete collection of the texts used for industrial training in the German continuation schools, an extensive high-school and college exhibit of the raw materials of commerce, a kindergarten and a Montessori exhibit, and other appropriate material.

The educational laboratory has a collection of apparatus for demonstration, and of instruments of precision for research in connection with school hygiene, the experimental study of school children (with special reference to the conduct of physical and mental tests), and the psychological phases of education in general. This equipment is constantly being enlarged and apparatus needed for special investigation is at once procured. The results of investigations pursued in the laboratory are published in the *Journal of Educational Psychology*.

Graduate students selecting education as their major subject will be expected to take from one-half to two-thirds of their work in the studies that are fundamental to an adequate mastery of educational theory and practice. These fall naturally into two groups, the philosophical and the social. The philosophical studies include psychology, ethics, and the history of philosophy; the social studies include political, social, and economic science. All graduate study in education presupposes familiarity with the history and principles of education and with educational psychology. Candidates for advanced degrees whose preparation in this respect is inadequate must make up this deficiency by taking the appropriate undergraduate courses.

Principles of Education; Present Problems in Education; History of Education; Educational Psychology; School Hygiene; Elementary Education.

The following advanced courses were given in 1913-14. They are substantially what may be expected for the ensuing year.

The Education of Exceptional Children. Assistant Professor WHIPPLE.

Mental Development. Assistant Professor WHIPPLE.

School Administration. Professor DEGARMO.

Philosophy of Education. Professor DEGARMO.

Mental Tests. Assistant Professor WHIPPLE.

Ethical Training in Secondary Schools. Professor DEGARMO.

Seminary for Experimental Investigation. Assistant Professor WHIPPLE.

Aesthetic Education. Professor DEGARMO.

Seminary for the Science and Art of Education. Professor DEGARMO and Assistant Professor WHIPPLE.

Reading of German Educational Psychology. Assistant Professor WHIPPLE.

HISTORY AND POLITICAL SCIENCE

The subjects of history and political science have been united since 1887 in the President White School of History and Political Science, which bears the name of the first president of the University, in especial recognition of the gift of his valuable collection of historical literature to the University Library.

The aims of the President White School are threefold: first, the advancement of knowledge by investigation and publication in the fields of history, economics, politics, jurisprudence, and social science; second, the training of scholars and teachers in these departments of study; third, the training of men and women for the public service, for business, and for professions such as law, journalism and philanthropy.

The School issues the Cornell Studies in History and Political Science, of which three volumes have appeared.

1. Money and Credit Instruments in their Relation to General Prices. By Edwin Walter Kemmerer, Ph.D., now Professor in Princeton University. First edition, 1907. Second edition, 1909.

2. Sargon of Assyria. By Albert Ten Eyck Olmstead, Ph.D., now Assistant Professor of History in the University of Missouri. 1908.

3. The Judicial Work of the Comptroller of the Treasury. By Willard E. Hotchkiss, Ph.D., now Dean of the School of Commerce, Northwestern University. 1910.

HISTORY

Professors: G. L. BURR, Medieval History; NATHANIEL SCHMIDT, Oriental History; C. H. HULL, American History; R. C. H. CATTERALL, Modern European History; H. A. SILL, Ancient History; J. P. BRETZ, American History; W. E. LUNT, Modern European History.

A graduate student in history should have a sufficient knowledge of general history and of geography. He should be able to speak and write good English. He should have a reading knowledge of French, of German, and of any other language necessary for the thorough study of his special subject. It is highly desirable that he should have had the necessary linguistic training as an undergraduate; but deficiencies in this respect may sometimes be made up after entering upon graduate work.

The University Library contains some eighty or ninety thousand volumes dealing with history. In large part these are to be found in the room known as the White Historical Library. Graduate students have immediate access to this rich group of books, which, with its many special collections, offers every facility for training in the methods of minute and exhaustive research. The historical seminary rooms in the library building are amply furnished with atlases, cyclopedias, dictionaries, bibliographies, and other useful works of reference, and afford easy access to the shelves of the library proper.

It has from the outset been the policy of the University, while providing adequately for the symmetrical growth of the library, to acquire the richer private collection of books which eminent scholars have through a lifetime of study built up as their tools of research. Thus, for the study of Oriental History, Cornell has been endowed with the EISENLOHR COLLECTION on the history of Egypt and that of President White on the history of Palestine. For the study of the Graeco-Roman world, it acquired that of Charles Anthon. For the Middle Ages, it has notable bodies of books on the birth of the Papal state, on the rise of the Carolingian empire, and, in general, on the relations of Church and State. For the Renaissance, it can boast the unrivaled FISKE COLLECTIONS on Dante and Petrarch and the world of their time. For the age of the Reformation, for the history of superstition and persecution (notably for Inquisition and Index, for the story of witchcraft, for the beginning of the sciences, for the rise of tolerance), it is equipped with the riches of the PRÉSIDENT WHITE LIBRARY; and for the study of the French Revolution that library has no equal on this side of the Atlantic, if anywhere outside of France. For the history of America, the University possesses the library of the historian Jared Sparks, with the MAY COLLECTION on American slavery, and the White collection on the Civil War. Professor Goldwin Smith enriched it with his working library of English history; it obtained that of Professor Tuttle on Prussia; from Professor Fiske came one singularly complete on Iceland. In a multitude of narrower fields it has been found possible to gather for the special student materials for exhaustive research. Many of these collections are endowed with special funds for their increase; and all have been steadily built up with an eye to the needs of the mature student of history.

Two fellowships and a scholarship are annually awarded to graduate students of history. The President White Fellowship in Modern European History has a value of \$600. It may be granted as a travelling fellowship. The Fellowship in American History amounts to \$500. The Graduate Scholarship in History amounts to \$300. There are six assistantships in history, which are filled preferably by the appointment of graduate students.

The teachers and graduate students of history have formed a History Club, which meets once a month for the reading and discussion of papers on historical topics and for social intercourse.

Ancient History

Greek History.

Roman History.

Greek History in the Fifth and in the Fourth Century. Professor SILL.

The Macedonian Monarchies and the Hellenistic Age. Professor SILL.

Roman History, the Revolutionary Period. Professor SILL.

The Roman Empire from Augustus to Constantine. Professor SILL.

Roman Law. Professor SILL.

Seminary in Greek and Roman History. Professor SILL.

History of Asia; History of Africa. Professor SCHMIDT. See under Semitics.

Medieval History

The Middle Ages (300-1300 A.D.).

Renaissance and Reformation (1300-1600). Professor BURR.

The Rise of Tolerance. Professor BURR.

Medieval Life. Professor BURR.

Seminary in Medieval History. Professor BURR.

Canon Law. Professor BURR.

Modern European History

English History.

History of Modern Europe (1600-1815).

English Constitutional History. Professor LUNT.

English History during the Tudor Period. Professor LUNT.

English History during the Stuart Period. Professor ———.

English History during the Eighteenth Century. Professor LUNT.

English History from 1801 to the Present. Professor LUNT.

Selected Topics for Research in English History of the Thirteenth and Fourteenth Centuries. Professor LUNT.

The French Revolution. Professor CATTERALL.

History of Prussia, 1714-1786. Professor CATTERALL.

France under Napoleon. Professor CATTERALL.

Seminary in Modern European History. Professor CATTERALL.

American History

American History from the Period of Discovery to 1815; American History, 1815-1892; Economic History of the United States (1600-1890).

Constitutional History of the Colonies and States to 1780. Professor HULL.

Constitutional History of the United States since 1860. Professor BRETZ.

History of the United States, 1850-1861. Professor HULL.

The Settlement of the Middle West. Professor BRETZ.

Religious Organizations in the Colonial and Early National Period. Professor BRETZ.

Seminary in American History. Professors HULL and BRETZ.

General Courses

The History of Civilization.

The Sciences Auxiliary to History (their aims, methods, literature, and use to history). Professor BURR.

Historical Geography. Professor BURR.

Paleography and Diplomatics. Professor BURR.

Historical Method (the nature, scope, materials, and method of history). Professor BURR.

- The Teaching of History. Professor BURR, with aid from his colleagues.
 Introduction to the Literature of History (a general survey, period by period, of the sources and literature of history). Professors SCHMIDT, SILL, BURR, CATTERALL, LUNT, HULL, and BRETZ.
 The Jacob H. Schiff Lectures, 1912-13: The Origin and Growth of the German Empire. Professor ERICH MARCKS of Hamburg, Germany.
 The Goldwin Smith Lectures, 1912-13: The Place of Representative Institutions in the Development of Civilization. Professor A. F. POLLARD of the University of London.

POLITICAL SCIENCE

- Professors: W. F. WILLCOX, Economics and Statistics; A. S. JOHNSON, Economics and Distribution; A. A. YOUNG, Economics and Finance; S. P. ORTH, Economics and Politics; G. N. LAUMAN, Rural Economy; JOHN BAUER, Economics; J. R. TURNER, Economics; R. S. SABY, Political Science; R. G. BLAKEY, Economics.
 Instructors: A. P. USHER, Economics; F. H. GILMAN, Economics; H. E. SMITH, Economics.

A graduate student in economics should have studied at least the equivalent of elementary courses in economics, economic history, politics, and social science. If he has not done this, he should take such elementary courses as early as possible; he will not ordinarily be allowed to present any of them as partial fulfillment of the requirement for a major or minor in any branch of political science. He should also have sufficient knowledge of French and German to be able to read necessary works in either language.

The work in political science in the President White School of History and Political Science falls into five divisions: economics, politics, statistics and social science, finance and distribution. These divisions aim to bring their work into close relationship with social, political, and business life. The members of the Faculty seek to keep in touch with the practical as well as the with purely scientific aspects of the problems treated, and have among their interests the preparation of students for positions in business and in public service.

In statistics and social science, work is offered mainly in statistics, but to some degree also in the less definite field of social science. The statistical method has been found of especial service both in developing a scientific and judicial attitude and in bringing out many facts about social life not discoverable in any other way. After the introductory course in social science, an advanced course is open which deals with the dependent or semi-dependent classes and the care for them exercised by society, in part through governmental agencies and in part through private philanthropy.

In economics and distribution, a graduate course is offered in the theory of value and distribution, which is designed to familiarize the student with the main currents of contemporary economic thought. For undergraduates are offered courses covering the history of economics, the more general economic aspects of the labor problem, the history and theory of socialism, and the organization and methods of socialistic parties.

In economics and finance, a research course is offered to graduate students which is designed to afford training in the appropriate methods of investigation

and to give familiarity with the fundamental sources of information. Other courses in this field open to graduates cover the more important economic aspects of both public and private finance.

This group uses two laboratories and several class rooms in proximity to each other and to the four division offices and one general office, an arrangement which has greatly facilitated intercourse between teachers and graduate students as well as among graduate students themselves. In the political science seminary room at the University Library and in the various offices and laboratories occupied by these departments, numerous publications in politics and in economics, such as market letters of leading brokers and technical business journals, are accessible to advanced students. The laboratories for classes in statistics and finance are supplied with standard and current books dealing with these subjects and with various mechanical devices for simple statistical processes and for securing a graphic and effective presentation of results.

In the closely related subject of rural economy or agricultural economics, courses are offered dealing with the general economic and social problems of the open country arising from the growing complexity and intensity of agriculture and its relation with commerce, manufacturing, and transportation.

One teaching assistantship yielding \$500 and tuition; three fellowships, two yielding \$500 and one yielding \$600; and two assistantships, each yielding \$150 are filled each spring.

- Elementary Social Science. Professor WILLCOX.
- Demography or Population Statistics. Professor WILLCOX.
- Economic and Industrial Statistics. Professor WILLCOX.
- The Dependent Classes. Professor WILLCOX.
- History of Economic Theory. Professor JOHNSON.
- Value and Distribution. Professor JOHNSON.
- The Labor Problem. Professor JOHNSON.
- Socialism. Professor JOHNSON.
- Money and Banking. Professor YOUNG.
- Corporations and Trusts. Professor YOUNG.
- Railway Transportation. Professor YOUNG.
- Municipal Administration. Professor ORTH.
- State Administration. Professor ORTH.
- Elements of Business Law. Professor ORTH.
- Elements of Public Law. Professor ORTH.
- American Party System. Professor ORTH.
- Constitutional Government. Professor ORTH.
- Accounting. Assistant Professor BAUER.
- Advanced Accounting. Assistant Professor BAUER.
- Insurance. Assistant Professor BAUER.
- Political Institutions. Assistant Professor SABY.
- Comparative Politics. Assistant Professor SABY.
- International Law. Assistant Professor SABY.
- History of Political Thought. Assistant Professor SABY.
- Modern Political Thought. Assistant Professor SABY.
- Financial History of the United States. Assistant Professor BLAKEY.
- Public Finance. Assistant Professor BLAKEY.

The Industrial Revolution in England. Dr. USHER.

Social and Economic Problems of the 19th Century in England. Dr. USHER.

Investments. Dr. SMITH.

Research in Statistics. Professor WILLCOX.

Research in Finance. Professor YOUNG.

Research in Politics. Professor ORTH.

Research in Accounting. Assistant Professor BAUER.

Research in Insurance. Assistant Professor BAUER.

General Seminary. Attended by all teachers in political science and all graduate students with majors in that field.

MATHEMATICS

Professors: JAMES McMAHON; J. H. TANNER; J. I. HUTCHINSON; VIRGIL SNYDER; F. R. SHARPE; W. B. CARVER; ARTHUR RANUM; D. C. GILLESPIE.

Instructors: C. F. CRAIG; F. W. OWENS; J. V. MCKELVEY; L. L. SILVERMAN; W. A. HURWITZ.

The graduate work provides instruction in the principal branches of mathematics and furnishes preparation and material for independent investigation. Only a portion of the whole field can be covered by the courses given in a single year. The courses are, therefore, changed from year to year in order to meet the needs of the students.

In addition to the regular instruction, individual guidance and advice are offered to any student who wishes to follow a particular line of inquiry.

The equipment in mathematics consists of a collection of about three hundred models, including plaster models of the quadric and cubic surfaces, of several forms of the Kummer surface, of the cyclides, of surfaces of centers of quadrics, and of minimum surfaces; plaster models illustrating positive, negative, and parabolic curvature, and constant measure of curvature; plaster models illustrating the theory of functions, among them models of simply and multiply connected surfaces and of several forms of Riemann's surfaces, and models representing the real parts of algebraic, exponential, logarithmic, and elliptic functions; wooden and glass models of crystals and polyhedra; wire and thread models of twisted curves and ruled surfaces, and skeleton frames for minimum surfaces.

The University Library has a large collection of books on pure and applied mathematics, including collected works of mathematicians, complete sets of all the important mathematical journals, transactions, and other publications of scientific societies, and doctoral theses from the leading American and European universities.

The Oliver Mathematical Club, composed of teachers and advanced students, meets weekly and has for its object the systematic presentation, by the members, of some specified mathematical theory of recent development, and of reports on noteworthy articles in current journals and on the results of special reading and investigation.

Solid Geometry; Advanced Algebra; Trigonometry; Analytic Geometry; Differential Calculus; Integral Calculus.

Descriptive Geometry. Professor SNYDER.

Algebra. Professor SNYDER.
 Elementary Differential Equations. ————
 Advanced Calculus. Dr. McKELVEY.
 Infinite Series. Dr. SILVERMAN.
 Theory of Functions of a Complex Variable. Dr. CRAIG.
 Elliptic Functions. Professor HUTCHINSON.
 Differential Equations of Physics. Dr. HURWITZ.
 Calculus of Variations. Professor GILLESPIE.
 Projective Geometry. Professor CARVER.
 Line Geometry. Professor RANUM.
 Probability and Insurance. Professor McMAHON.
 Mechanics. Dr. OWENS.
 Potential Function and Spherical Harmonics. Professor SHARPE.

PHYSICS

Professors: E. L. NICHOLS; ERNEST MERRITT; FREDERICK BEDELL; J. E. TREVOR; J. S. SHEARER; G. S. MOLER; ERNEST BLAKER; F. K. RICHTMYER; R. C. GIBBS.

Instructors: R. C. RODGERS; C. C. MURDOCK; E. C. MAYER; C. C. BIDWELL; O. E. BUCKLEY; C. E. POWER; G. E. THOMPSON; E. H. KENNARD; T. B. BROWN; R. W. KING; W. P. DAVEY; K. S. GIBSON.

In the subjects of physics, opportunities are offered for study and investigation in theoretical physics and in various experimental branches of the science.

The facilities for radiometric and spectrophotometric work, for the investigation of the properties of matter throughout a very wide range of temperatures, in the application of photographic methods to problems in experimental physics, and in electricity, especially for the study of alternating current phenomena, etc., are exceptionally good.

Forty rooms in Rockefeller Hall are set aside for advanced workers. Research is organized as a distinct division with its own equipment, stock, and apparatus room, well equipped workshop for the use of graduate students, complete appliances for the production and handling of gases, including generators, low and high pressure storage tanks, compressors, and power driven vacuum pumps, etc. An instrument-maker's shop with two mechanics is devoted solely to the construction and repair of apparatus.

During the year 1914-15, Professor NICHOLS will direct the work of graduate students in experimental physics and particularly in radiation and luminescence; Professor MERRITT, in theoretical and experimental physics, particularly in electricity and magnetism and problems connected with luminescence; Professor BEDELL, in applied electricity, theoretical and experimental, and particularly in alternating-current phenomena; Professor SHEARER, in theoretical and experimental physics and particularly in work requiring the production and measurement of high and low temperatures; Professor TREVOR, in the theory of thermodynamics; Professor MOLER, in the design and construction of research apparatus and in work involving the use of photography; Professor BLAKER, in sound and illumination; Professor RICHTMYER, in photometry and illumination.

Introductory Experimental Physics; Introductory Physics; General Physics; Introductory Physical Experiments; Physical Experiments; Photometry and Illumination.

Heat. Assistant Professor BLAKER.

Light. Assistant Professor BLAKER.

Electricity and Magnetism. Assistant Professor BLAKER.

Properties of Matter. Assistant Professor BLAKER.

Sound. Assistant Professor BLAKER.

Advanced Laboratory Practice. Assistant Professor BLAKER.

Advanced Photography. Professor MOLER.

Alternating Currents. Professor BEDELL.

Electrical Laboratory Practice. Professor BEDELL.

Advanced course in Electrical Laboratory. Professor BEDELL.

Design and Construction of Apparatus for Research. Professor MOLER.

Recent Advances in Experimental Physics. Professor MERRITT.

History of Physics in the 19th Century. Professor NICHOLS.

Fluorescence and Phosphorescence. Professor NICHOLS.

Photometry and the Physics of Illumination. Professor NICHOLS.

Photometry and Illumination. Assistant Professor RICHTMEYER.

Spectrophotometry. Assistant Professor RICHTMYER.

Theory of Light. Professor SHEARER.

Theory of Heat. Professor SHEARER.

Reading Course on the Electromagnetic Wave Theory. Professor SHEARER.

The Application of Mathematics to Physics. Professor SHEARER.

Physical Seminary. Professor NICHOLS.

Theoretical Physics. Mechanics and Thermodynamics. Professor MERRITT.

Theoretical Physics. Electricity and Magnetism. Professor MERRITT.

Thermodynamics. Professor TREVOR.

CHEMISTRY

Professors: L. M. DENNIS, Inorganic Chemistry; W. R. ORNDORFF, Organic and Physiological Chemistry; W. D. BANCROFT, Physical Chemistry; E. M. CHAMOT, Sanitary Chemistry and Toxicology; G. W. CAVANAUGH, Agricultural Chemistry; A. W. BROWNE, Inorganic and Analytical Chemistry; L. J. CROSS, Agricultural Chemistry; C. W. BENNETT, Physical Chemistry; G. E. F. LUNDELL, Analytical Chemistry.

Instructors: H. W. REDFIELD; T. W. B. WELSH; B. J. LEMON; R. P. ANDERSON; F. E. RICE; S. A. MAHOOD.

The chemical laboratory, Morse Hall, contains a floor space of about 100,000 square feet. It is provided with four lecture rooms, having a total seating capacity of five hundred and fifty-four, and with four recitation rooms. For elementary work in inorganic chemistry and in qualitative and quantitative analysis, there are three large laboratories containing in the aggregate places for about twelve hundred and eighty students working in sections. In addition to these, there are four rooms for organic chemistry, a special laboratory for microchemical analysis, one for the analysis of water and foods, together with two

incubator rooms and one sterilizer room, three rooms for assaying, two for gas analysis, a fireproof room for work with highly inflammable substances, a laboratory for combustion analysis, a hydrogen sulphide room connected with strong fan exhaust, an electric furnace laboratory, a large room for advanced inorganic chemistry, a room for spectroscopic chemical analysis, a large laboratory for elementary work in physical chemistry, one for electrochemistry, one for advanced work in agricultural chemistry, and a number of rooms devoted exclusively to research. Distilled water is conducted in block tin pipes to all the more important rooms on each floor from tin-lined tanks on the fifth floor. Air blast is conducted wherever required from a high pressure blower in the basement. The buildings are supplied with an alternating current of 2200 volts and with the usual direct current. Currents for electro-chemical analysis and synthesis are furnished by storage batteries. With the aid of a motor generator, low voltage direct currents up to 2000 amperes may be obtained. The chemical library contains complete sets of the more important journals, and is fully supplied with works of reference and with the standard books on chemistry and allied subjects.

A graduate student who desires to take either a major or a minor subject in chemistry may select any one of the following six branches: inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, sanitary chemistry, agricultural chemistry. Under the present procedure, both the major subject and the one minor subject required for the degree of Master of Arts or the major subject and the two minor subjects required for the degree of Doctor of Philosophy may be selected from the six divisions mentioned above, but it is desirable that candidates for the degree of Doctor of Philosophy select at least one minor subject outside of chemistry.

A graduate student who desires to take a minor subject in chemistry with some subject other than chemistry as the major subject, will be required to offer introductory inorganic chemistry and elementary qualitative and quantitative analysis as preliminary to his graduate work. The work upon his minor subject in chemistry may be taken in any branch of the subject that he is qualified to pursue, and may comprise advanced courses selected from the subjoined list, with approval of his special committee.

Candidates for the degree of Master of Arts, or for that of Doctor of Philosophy, with the major subject in chemistry will be expected to have a reading knowledge of French and German and will be required to offer as preliminary to their graduate work in chemistry the following subjects: introductory inorganic chemistry, elementary qualitative and quantitative analysis, advanced quantitative analysis, spectroscopic chemical analysis, gas analysis, elementary organic chemistry, microchemical methods, and elementary physical chemistry. Courses in these subjects, if taken in another university, will be accepted if they are substantially equivalent to the courses offered at Cornell. Graduate students entering from other universities may take during their residence for the advanced degree such of the above courses as they have not already pursued. If a graduate student lacks at entrance several of these preliminary courses longer residence may be necessary. More advanced courses may be elected from the appended list, with the approval of the special committee.

Introductory Inorganic Chemistry; Qualitative and Quantitative Analysis; Qualitative Analysis; Quantitative Analysis, Elementary Course.

- Advanced Qualitative Analysis. Laboratory practice. Dr. LEMON.
Quantitative Analysis. Advanced Course. Assistant Professor LUNDELL and Messrs. O'BRIEN, MILLER, and VAN DER MEULEN.
Quantitative Analysis. Advanced lectures. Assistant Professor LUNDELL.
Electrochemical Analysis. Laboratory practice. Assistant Professor LUNDELL and Mr. VAN DER MEULEN.
Optico-Chemical Methods. Lectures and laboratory. Dr. ANDERSON and Messrs. ENGELDER and STORY.
Assaying. Lectures and laboratory. Assistant Professor LUNDELL and Mr. VAN DER MEULEN.
Qualitative and Quantitative Gas Analysis. Lectures. Dr. ANDERSON.
Technical Gas Analysis. Laboratory practice. Dr. ANDERSON and Messrs. ENGELDER and STORY.
Gas Analysis, Advanced Course. Laboratory practice. Dr. ANDERSON.
Organic Chemistry. Professor ORNDORFF, and Messrs. MAHOOD, ROSE, KENNEDY, and F. W. SHERWOOD.
Organic Chemistry. Lectures. Professor ORNDORFF and Messrs. KENNEDY and F. W. SHERWOOD.
Elementary Organic Chemistry. Messrs. MAHOOD, ROSE, KENNEDY, and F. W. SHERWOOD.
Special Chapters in Organic Chemistry. Professor ORNDORFF.
Advanced Organic Chemistry. Laboratory practice. Professor ORNDORFF and Mr. MAHOOD.
The Coal Tar Dye Stuffs. Professor ORNDORFF.
Stereochemistry. Professor ORNDORFF.
Methods of Organic Analysis. Laboratory Practice. Professor ORNDORFF and Mr. MAHOOD.
Inorganic Chemistry. Advanced Course. Professor DENNIS.
Inorganic Chemistry. Laboratory Practice. Professors DENNIS and BROWNE, and Mr. RHODES.
Selected Topics in Advanced Inorganic Chemistry. Professor BROWNE.
Chemistry of Gases. Lectures. Dr. ANDERSON.
Introductory Physical Chemistry. Lectures. Assistant Professor BENNETT.
Physical Chemistry Laboratory. Assistant Professor BENNETT, and Messrs. GILBERT and LEIGHTON.
Advanced Physical Chemistry. Professor BANCROFT.
Colloid Chemistry. Professor BANCROFT.
Theoretical Electrochemistry. Professor BANCROFT.
Applied Electrochemistry. Lectures. Assistant Professor BENNETT and Mr. DAVISON.
Applied Electrochemistry. Laboratory. Assistant Professor BENNETT and Mr. DAVISON.
Advanced Laboratory Practice. Professor BANCROFT, Assistant Professor BENNETT, and Messrs. GILBERT, DAVISON, and LEIGHTON.
Microchemical Methods. Laboratory. Professor CHAMOT and Mr. C. M. SHERWOOD.
Microchemical Analysis. Laboratory. Elementary Course. Professor CHAMOT and Mr. C. M. SHERWOOD.

Microchemical Analysis. Laboratory. Advanced Course. Professor CHAMOT.

Microscopy of Metals and Alloys. Professor CHAMOT and Mr. ———.

Elementary Sanitary Chemistry. Lectures and Laboratory. Professor CHAMOT and Dr. REDFIELD.

Special Topics in Food Examination. Dr. REDFIELD.

Microscopic Examination of Foods. Professor CHAMOT and Mr. C. M. SHERWOOD.

Special Topics in Water Examination. Professor CHAMOT.

Advanced Sanitary Chemistry. Laboratory. Professor CHAMOT, Dr. REDFIELD, and Mr. C. M. SHERWOOD.

Toxicology. Professor CHAMOT.

Agricultural Chemistry. Lectures and Recitations. Professor CAVANAUGH, Assistant Professor CROSS, and Mr. RICE.

Agricultural Chemistry. Laboratory Practice. Professor CAVANAUGH, and Mr. RICE.

Agricultural Chemistry. Advanced Courses. Lectures. Assistant Professor CROSS.

Agricultural Analysis. Laboratory Practice. Assistant Professor CROSS, and Mr. RICE.

Advanced Agricultural Analysis. Laboratory Practice. Professor CAVANAUGH and Assistant Professor CROSS.

Household Chemistry. Lectures. Professor CAVANAUGH.

Household Chemistry. Laboratory Practice. Professor CAVANAUGH and Mr. RICE.

Seminary.

Research for undergraduate students.

GEOLOGY

Under the general title of geology are included dynamic geology, physical geography, meteorology, mineralogy, crystallography, petrography, paleontology and stratigraphic geology, economic geology.

Professors: HEINRICH RIES, Economic Geology; G. D. HARRIS, Paleontology and Stratigraphic Geology; A. C. GILL, Mineralogy and Petrography; O. D. VON ENGELN, Physical Geography; W. M. WILSON, Meteorology.

Instructors: J. S. HOOK, Economic Geology; P. G. SHELDON, J. STORRER, E. D. ELSTON, V. E. MONNETT, Geology; R. E. SOMERS, Economic Geology.

Dynamic Geology, Physical Geography, and Meteorology. The region round about Ithaca abounds in excellent and varied illustrations of physiography, glaciology, and dynamic geology, and consequently abundant opportunity is offered for research. For many years the teachers and advanced students have been engaged in an investigation of the field problems, and these studies will be continued.

In addition to field work, there are excellent facilities for indoor work. The main laboratory is well equipped with topographic maps and photographs; the collection of relief models is notably complete, and there is an experimental laboratory with apparatus and facilities for carrying on a variety of experiments

in the development of land forms, etc. In the main laboratory is a special library of reference works on geographic subjects.

For admission to the advanced courses it is required that the student have a working knowledge of the fundamental principles of the subject and have completed some reading other than textbooks. These courses serve in the training of students for positions in the better grade of secondary and normal schools, in colleges and universities, in the national geological survey, in exploring expeditions, and for research.

Candidates for advanced degrees whose major subjects are in physical geography should have completed, during their undergraduate training, elementary university courses in physics (including an advanced course in heat), chemistry, mathematics, and economics; in addition to introductory courses in physical geography, dynamic geology, stratigraphy, mineralogy, petrography, and economic geology.

Mineralogy, Crystallography, and Petrography. The laboratory equipment is relatively good as regards petrographic microscopes, apparatus for chemical and physical investigations of rocks, and apparatus for special crystallographic determinations. There are also collections of rocks and study collections of minerals. The largest of the latter includes the Benjamin Silliman, jr. collection.

Special graduate courses in this division are not offered, but advanced work is adapted to the needs of the individual. Two of the elementary courses are, however, so dependent on a rather advanced knowledge of physics or of chemistry, or of both, that they are to be considered as requiring the maturity of graduates, although open also to undergraduates with sufficient preparation. These are the courses in optical determination of minerals and petrography. For graduate work in these subjects a student should have chemistry, including quantitative analysis, and a good knowledge of general physics. For petrography he should have also not less than a year of general geology.

Paleontology and Stratigraphic Geology. The University is so located that excellent exposures of Devonian formations are at its very door, and the typical sections of New York State, which are of fundamental importance in American paleozoic geology, are within short excursion range. The most important of these are the Rochester and Niagara gorges, Trenton Falls, and the Helderberg escarpments, the Chemung Valley, and the coal fields in northern Pennsylvania. Summer field work has been carried on over a still greater range, extending to Plattsburg on the north and to the Carolinas on the South, giving the student at small cost, a chance to study a large portion of the geological column at first hand.

Facilities for those prepared to engage in research in paleontology and stratigraphic geology are furnished by the results of four summer expeditions from the University into the Tertiary areas of the United States; eleven seasons' work in Louisiana, two in Arkansas, two in Texas, one in Europe; the results of numerous exchanges; the Newcomb collection (10,000 species) of recent shells; and the exceptional wealth of conchological literature in the geological and the general library. The *Bulletin of American Paleontology*, the only paleontological journal in the country, is published in the department.

Economic Geology. The work in economic geology is designed to familiarize the student with the origin, occurrence, and distribution of the mineral products,

of economic value, and also the practical application of geologic principles. The laboratory contains an excellent study collection of economic materials, from the United States, Canada, Mexico, and Europe, including ores, fuels, clays, abrasives, building stones, etc., most of these representing suites of material collected by members of the staff of instruction on geological trips. This collection is supplemented by maps and models. The departmental library contains a number of reports and books on economic geology; and the University Library has an especially full set of works covering this special field.

In addition to the collections, the economic geology laboratory has facilities for general work and research on economic materials, the equipment for clay investigation being especially large.

The work of graduate instruction consists in part of lectures and in part of special work arranged to suit the needs of the individual student. Those students registered for a major subject in economic geology are expected to engage in research, which should preferably be based on field work.

Excursions may readily be taken to the anthracite region of Pennsylvania; the iron, slate, cement, and talc region near Easton, Pa.; the magnetite mines of the Adirondacks, etc. Field trips of greater or less length are taken to some of these localities every year.

Dynamic Geology, Geology, Elementary Physical Geography; Geography of North America; Geography of Europe; Meteorology and Climatology; Elementary Mineralogy; General Lithology; Crystallography; Blowpipe Determination of Minerals.

Glaciers and Glaciation. Assistant Professor VON ENGELN.

Experimental Physiography. Assistant Professor VON ENGELN.

Seminary. Assistant Professor VON ENGELN.

Physiographic Research. Assistant Professor VON ENGELN.

Mineralogy. Professor GILL and ———.

Crystal Measurement and Drawings. Professor GILL.

Optical Determination of Minerals. Professor GILL.

Petrography. Professor GILL.

Seminary in Mineralogy and Petrography. Professor GILL.

Advanced or Special Work in Mineralogy and Petrography. Professor GILL.

Stratigraphic Geology. Professor HARRIS.

Paleontology. Professor HARRIS.

Research and Conference. Professor HARRIS and Dr. SHELDON.

Building Stones and Clay Products. Professor RIES and Mr. HOOK.

Practical Geology. Professor RIES and Mr. SOMERS.

General Economic Geology. Professor RIES and Mr. HOOK.

Field Examination of Mineral Deposits. Professor RIES.

Mining of Mineral Deposits. Mr. SOMERS.

Clay Investigation. Professor RIES and Mr. HOOK.

Advanced Economic Geology. Professor RIES.

Economic Geology Seminary. Professor RIES.

Seminary in Foreign Literature. Professor RIES.

Experimental Economic Geology. Professor RIES and Mr. HOOK.

BOTANY

Professors: G. F. ATKINSON; W. W. ROWLEE.

Instructor: CHARLES OTIS.

The laboratories for advanced work and research are well equipped with apparatus and materials such as microscopes, microtomes, ovens, sterilizers, thermostats, water baths, cameras for photographic and photomicrographic work, culture rooms, electric lantern, etc. The laboratories are directly connected with well-stocked greenhouses. These contain a large assortment of exotic plants, which afford material for illustration and comparison, as well as material for investigation. The greenhouses also afford space for experimental work in plant physiology and morphology, and for the growing of plants under observation. There are excellent facilities for field work in the vicinity of the University.

The University Library contains the more important periodicals and complete sets of journals relating to botanical science, and a large collection of special works devoted to the various subdivisions of the science, as morphology, embryology, histology, physiology, mycology, and the different systematic subdivisions. The works most frequently required for reference are kept in the departmental library.

The botanical seminars offer opportunity for keeping in touch with the current literature of the subject, and of dealing with the theoretical and practical aspects of the various problems under investigation.

As a prerequisite for graduate work in botany, either as a major or as a minor subject, the student should have a thorough knowledge of the fundamental principles of the science. In addition, some prerequisite or supplementary advanced work in morphology, organography, histology, and taxonomy (according to the nature of the subject chosen by the candidate) will be required. When the candidate has not had the desired advanced work it may be taken as preliminary or parallel work with his investigation, by registering in such of these courses as the special committee may determine, but none of the courses indicated will be accepted as meeting the requirement for either the major or the minor subject.

General Comparative Morphology of Plants; Elementary Plant Physiology; Special Morphology, Taxonomy, and Ecology of the Higher Plants; Geographical Botany; Organography and Identification of the Higher Plants; Taxonomy and Phylogeny of Angiosperms; Plant Cytology; Comparative Histology of Plants; Dendrology; Xylogy; Comparative Morphology and Embryology; Mycology; Taxonomy of the Pteridophytes, Bryophytes, and Algae; Research in Morphology and Embryology; General Taxonomic Survey of the Fungi.

Research in Comparative Morphology, Embryology, and Experimental Morphology. Professor ATKINSON and Dr. OTIS.

Research in Mycology and Plant Pathology. Professor ATKINSON.

Research in Taxonomy and Phylogeny of the Angiosperms. Professor ROWLEE.

Research in Comparative Histology and Cytology. Professor ROWLEE and

Seminary in Morphology, Embryology, Mycology, Physiology, etc. Professor ATKINSON.

Seminary in Comparative Histology and Taxonomy of the Angiosperms. Professor ROWLEE.

BOTANY AND PLANT PHYSIOLOGY

[in the College of Agriculture]

Professors: K. M. WIEGAND; LEWIS KNUDSON.

Instructors: H. P. BROWN; O. F. CURTIS; A. J. EAMES; L. H. MACDANIELS; C. C. THOMAS; W. J. ROBBINS; MRS. M. C. WIEGAND; J. K. WILSON.

The laboratories of this department are located in the agronomy building of the College of Agriculture. Those devoted to general botany are supplied with microscopes, herbarium, and preserved material, microtomes, paraffin baths, and other apparatus and material suitable for carrying out research work in taxonomic botany of the higher plants, and in plant histology. In connection with research work in general botany, the very rich flora of Ithaca and vicinity makes the location a particularly desirable one. Gardens and greenhouses are also available for the growing of experimental material. The work in plant physiology is conducted in laboratories equipped with special reference to the demands of advanced instruction and research. Supplementary laboratory space is provided in two headhouses and a greenhouse of twenty-five by fifty feet, these especially giving additional accommodations for the experimental work.

The class work in plant physiology is done in one large, well-lighted, ground-floor laboratory, provided with the necessary facilities for the study of the microscopic, the chemical, and the physical aspects of the subject. The necessary microscopic outfits, lockers, and apparatus required in general physiology are available. Accommodations are made for thirty-five students in a section.

In an equivalent laboratory on the first floor excellent facilities and equipment are provided for research in plant physiology. The department possesses seven incubators, drying oven, and paraffin oven, all electrically heated and equipped for temperature control. Recording hygrometers and thermometers, balances, microtomes, photomicrographic apparatus, and a considerable number of other important large pieces of apparatus are included. There is also available a plentiful supply of all small apparatus which may be necessary.

To graduate students in physiology, desks are assigned in small adjacent rooms which serve as headquarters for their supplies and records. Special effort has been made to give opportunities for individual investigation, particularly in such phases of the work as nutrition, respiration, the relation of plants to climatological, and other factors of the environment, the physiology of fermentation, effects of external agencies in heredity, and cell physiology.

The University Library is very well equipped with special works and periodicals dealing with all phases of botanical science. A department library is established in connection with the laboratories in which those books are kept that are in frequent use.

A seminary in general botany and histology is conducted in which recent literature and special phases of botanical science are taken up for special discus-

sion. In this seminary the student can not only keep abreast of the literature, but will find opportunity for the discussion of special phases of his own research.

A corresponding seminary in plant physiology offers to graduate students an opportunity to become familiar with current work in plant physiology and to consider the relations of this work to agricultural practices. At these meetings there are also held general conferences and discussions of opinions or methods not conveniently or appropriately dealt with in the general courses. All graduate students in plant physiology are required to take part in the work of this seminary and to gain experience in presenting the results of their own research, or in developing opinions respecting the work of others.

As a prerequisite for work in general botany and histology the student will be expected to have a knowledge of fundamental features of botanical science, and, in case of a major, the student will be expected to have had advanced courses in general botany or plant histology, depending upon whether his work lies in one or the other of these branches. In case of a minor, if the advanced courses have not already been taken by the student, he will be expected to take these during his work, and they may count in part toward the work which he offers for his degree.

In order to pursue graduate work in plant physiology, students must have had good scientific preparation. Special training in general biology, botany, or chemistry is essential. In no case, however, may a graduate enter upon topical work or research without the equivalent of eight hours advanced work in courses in the subject. Special training in certain aspects of horticultural or agronomic work is also recognized as satisfying a general standard of scientific preparation.

General Elementary Botany; Forest Botany; General Plant Physiology.

Taxonomy of the Higher Plants. Professor WIEGAND.

Histology. Professor WIEGAND, and Dr. EAMES.

Cytology. Professor WIEGAND.

Research in General Botany, Histology, and Taxonomy. Professor WIEGAND.

Seminary in General Botany, Histology, Taxonomy. Professor WIEGAND.

Physiology of Fermentation. Assistant Professor KNUDSON, and Mr. ROBBINS.

Physiology of Bacteria. Assistant Professor KNUDSON.

Advanced Plant Physiology. Assistant Professor KNUDSON, and Messrs. ROBBINS and CURTIS.

Special Chapters in Metabolism. Assistant Professor KNUDSON.

Research in Plant Physiology. Assistant Professor KNUDSON.

Seminary in Plant Physiology. Assistant Professor KNUDSON.

FLORICULTURE

Professors: E. A. WHITE; A. C. BEAL.

Instructor: R. H. PATCH.

Comparatively little research has been done in floriculture. The field is a broad one, and there are splendid opportunities for original work along this line. Problems on variation, nutrition, culture and improvement of plants may be

undertaken. Monographic studies on the various genera of ornamentals offer an important field for study. Summer work is of special importance with flower crops, and it is desirable that candidates for the Master's degree spend at least one summer at the University. This is required of all candidates for the Doctor's degree.

Every candidate for an advanced degree in floriculture must have had a thorough training in general biology, botany, economic entomology, soils, fertilizers, and genetics. A student who takes his major subject in this department must have had the courses noted below or their equivalent, with the exception of courses in investigation and seminary. A student who takes his minor subject for the Master's degree may register for these courses. All candidates must submit a typewritten, bound thesis, a copy of which shall be left with the department.

In addition to the classroom and laboratory equipment, a new range of greenhouses, aggregating eight thousand square feet of glass is now available for instructional purposes, and additional glass is expected in the near future. The department has about thirty acres of land devoted to field experiments with peonies, gladioli, irises, roses, asters and other annual and perennial plants. This area also furnishes material for laboratory exercises.

The library equipment consists of a large and steadily-increasing collection of works of reference comprising a number of the rarer books of the ancients, an unusually full assortment of the garden herbals of the sixteenth, seventeenth, and eighteenth centuries, and the leading monographs and manuals of modern times, supplemented by complete sets of a large number of the horticultural journals of Europe and America. This large collection has also been supplemented by the gift of the extensive private library of the late Professor John Craig. The largest bound collection of seed, plant, and nursery catalogues in the United States is in the library of the department. This collection is very useful to students monographing horticultural plants. Students have access to an herbarium comprising about thirteen thousand cultivated plants.

Greenhouse Management. Professor WHITE.

Greenhouse Construction. Professor WHITE and Mr. PATCH.

Commercial Floriculture. Professor WHITE.

Greenhouse and Garden Practice. Professor WHITE.

Floral Arrangement. Mr. PATCH.

Conservatory Plants. Professor WHITE.

Garden Flowers. Professor WHITE and Mr. PATCH.

Amateur Floriculture. Professor WHITE.

Investigation. Professors WHITE and BEAL.

Seminary. Professors WHITE and BEAL.

POMOLOGY

Professors: C. S. WILSON; W. H. CHANDLER; H. B. KNAPP.

Instructors: L. W. ARNY; G. W. PECK; F. E. ROGERS.

In addition to the laboratory equipment, there is a fifty-acre field laboratory devoted to commercial and varietal orchards of the different fruits. As most of these plantings are young, the opportunities for research are unusually good.

On the grounds are also orchards on Paradise and Doucin stocks and a large collection of seedling stocks used for propagation.

Exceptional facilities are available for studying fruit packing, storing, and marketing. Special work is offered in the study of fruit varieties, adaptation of varieties to soil conditions, and in many other advanced subjects. Each year a large collection of fruit available for graduate use is brought together at the College. Fruit surveys have been made in several counties, and the data secured from these sources afford opportunities for studying the different phases of orchard management in the most important fruit-growing sections of the state.

As prerequisites for graduate work in pomology, the student should have a thorough knowledge of the fundamental principles of botany, plant physiology, soils, economic entomology, and plant pathology. In the field of pomology, the student must have taken elementary pomology, practical pomology, and systematic pomology in this department, or their equivalent in case the student enters from another college. Systematic pomology may be taken together with graduate work. A list of the courses which will be given by this department during the summer term of 1914 will be furnished on application.

On account of the nature of the work, it is very desirable that graduates studying for the Master's degree should spend one summer at Ithaca or in the field, investigating their special subject. Of graduates working for the Doctor's degree this is required.

Elementary Pomology; Practical Pomology; Elementary and Practical Pomology; Spraying of Fruit Trees.

Bush Fruits. Professor WILSON.

Nuciculture. Professor CHANDLER.

Spraying of Fruit Trees. Professor WILSON and Mr. ARNY.

Varieties and Judging. Professor WILSON and Mr. ARNY.

Systematic Pomology. Professor CHANDLER and Mr. ARNY.

Research in Pomology. Professors WILSON and CHANDLER, Assistant Professor KNAPP, and Messrs. ARNY and PECK.

Seminary. Professors WILSON and CHANDLER, Assistant Professor KNAPP, and Messrs. ARNY and PECK.

PLANT BREEDING

Professors: A. W. GILBERT; H. H. LOVE; C. H. MYERS.

Instructor: E. E. BARKER.

The equipment for this subject, including laboratory, greenhouses, and gardens, is designed primarily for investigation in experimental evolution. It is, however, available for the use of a limited number of graduate students.

The laboratory is well supplied with suitable microscopes, microtomes, paraffin ovens, etc., for use in histological investigations. It is also equipped with a full photographic outfit and calculating machines for the statistical study of variations. An excellent library dealing with plant breeding and experimental evolution, and an extensive card catalogue of plant-breeding literature form a part of the equipment. The private libraries of members of the staff, containing many valuable

books and pamphlets, are placed at the disposal of graduate students. An herbarium of variations of plants is in process of formation.

Graduate students have the use of two greenhouses, having a total floor space of 2000 square feet, for conducting investigations during the winter months. These houses are fully equipped with all necessary appliances for successful plant culture. They are divided into warm and cool houses, and certain of them have large headhouses.

Experimental Garden and Farm. A garden of three acres, of good fertility, is available for graduate students in which to grow hybrids and other plants during the summer. For more extensive plantings the department has the use of certain parts of the university farms.

During the first year of his work a candidate for the Doctor's degree is expected to spend some time in systematic reading. He is encouraged also to begin work on his minor subjects, with the expectation that the last period of study shall be devoted solely to research. It is expected that the student will complete his minor subjects (chosen outside of plant breeding) during term time in order that he may spend his summers on his major subject. The completion of many problems in plant breeding is dependent upon the number of generations of plants grown, and it is very necessary that a student taking this as his major subject start upon his problem during his first year of study. The development of this work will at first be slow and will therefore allow time for the minor subjects and for reading.

It is very desirable that students who are candidates for the Doctor's degree should remain in Ithaca during the summer, which is the best time for work in plant breeding.

The preparation of a person who expects to pursue graduate work in plant breeding should consist of a thorough training in botany, with special reference to cytology, physiology, and taxonomy; zoology, especially comparative morphology and embryology; mathematics; and philosophy.

General Genetics. Professor GILBERT and Mr. BARKER.

Plant Breeding. Mr. BARKER.

Methods of Plant Breeding. Professor GILBERT and Mr. BARKER.

Biometry. Professor LOVE. (Required of graduate students whose major subject is plant breeding).

Advanced Plant Breeding.

Research. Professors LOVE, GILBERT, and MYERS.

Seminary. Professors LOVE, GILBERT, and MYERS, and Mr. BARKER.

PLANT PATHOLOGY

Professors: H. H. WHETZEL; DONALD REDDICK; M. F. BARRUS; H. M. FITZPATRICK; V. B. STEWART.

Instructors: C. T. GREGORY; L. R. HESLER; H. W. RANKIN; I. C. JAGGER; R. A. JEHLE; R. J. HASKELL; J. ROSENBAUM.

There is a full equipment of apparatus for carrying on graduate work and research in this subject. The equipment includes especially constructed furni-

ture, and the most modern types of microscopes, microtomes, sterilizers, electric incubator, and paraffin bath for the work of teaching and investigation. The phytopathological herbarium includes, besides a local collection, complete sets of a number of the well known exsiccati such as Rabenhorst, Roumeguère, Ravanel, Seymour & Earle, Fungi Columbiana, etc. Considerable space in the greenhouses is devoted entirely to graduate work and research. The departmental library includes most of the important works on plant pathology, complete sets of the more important journals, and many monographs. The general library contains a fairly complete collection of mycological books.

During the growing season, the department maintains a number of field laboratories in the more important fruit and crop sections of the State, where members of the staff and graduate students may carry on their investigations. Each of these field laboratories has a complete equipment of apparatus, meteorological and other instruments, necessary for the most careful research.

A number of industrial fellowships, established during the past two years by growers or commercial concerns, are open to award from time to time. These provide exceptional opportunities for investigation, during a continuous period, of problems of great economic importance and scientific value. These fellowships, which are worth from \$500 to \$1000 a year, usually extend over a period of two years, and carry with them sums ranging from \$250 to \$500 to provide for travelling and living expenses, etc., in connection with the work in the field. These are known as temporary industrial fellowships.

Candidates for the Doctor's degree are required to spend at least one season in one of the field laboratories, in order that they may come in direct contact with the conditions and the practical aspects of control problems. They are also expected to spend some time in extension work, either at fairs or at institutes.

Candidates for advanced degrees must present evidence of fundamental training in general botany, plant physiology, and chemistry, and not later than the beginning of the second graduate year a reading knowledge of French and German.

Plant Pathology; Diseases of Field and Truck Crops; Diseases of Fruit and Fruit Trees; Diseases of Forcing-house and Florists' Crops; Dendropathology; Principles of Plant Disease Control.

Laboratory Methods in Plant Pathology. Professors WHETZEL and REDDICK.
 Etiology of Plant Diseases. Professor FITZPATRICK.

Phytopathological Technique. Professors WHETZEL and REDDICK, Assistant Professor BARRUS, and Messrs. GREGORY and HESLER.

Phytopathological Histology. Professor WHETZEL.

Research. Professors WHETZEL and REDDICK, and Assistant Professors BARRUS, FITZPATRICK, and STEWART.

Seminary.

ZOOLOGY

Professor: H. D. REED.

Instructors: A. H. WRIGHT; A. A. ALLEN.

Opportunity is offered for investigation in general zoology, systematic zoology, comparative anatomy, and ecology.

The museum contains representative forms of the various animal groups. In its formation, efforts have been made to obtain material from all parts of the world illustrating biologic and evolutionary ideas. Most of the families of animals are represented in the collection, and, in some of the major groups, most of the genera.

The large fauna of the Cayuga Lake basin, with its admixture of the Transitional, Canadian, and Upper Austral life zones and with its diverse topographic conditions, affords unusual opportunities for advanced work and research in ecology.

Every facility possible in the way of material and apparatus is placed at the disposal of students desiring to work in the above fields.

Aside from the elementary courses mentioned below, a student should have had courses in histology, and embryology. For investigation in ecology a knowledge of the fundamentals of physics, chemistry, geology, and physiology is necessary.

Elementary Zoology; Mammalian Anatomy based upon a study of the cat; Comparative Anatomy; Systematic Zoology and Ecology. These courses or their equivalents are prerequisite to graduate work.

Morphology and Embryology of Invertebrates. Assistant Professor REED and ———.

Comparative Morphology and Evolution of Vertebrates. Assistant Professor REED.

Advanced Systematic Zoology (two courses). Drs. WRIGHT, and ALLEN. Seminary.

ENTOMOLOGY, LIMNOLOGY, AND NATURE STUDY

Professors: J. G. NEEDHAM, Limnology and Nature Study; W. A. RILEY, Morphological Entomology; G. W. HERRICK, Economic Entomology; C. R. CROSBY, Entomological Investigations; J. C. BRADLEY, Systematic Entomology; G. C. EMBODY, Aquiculture; O. A. JOHANNSEN, Aquatic Nematocerosus Diptera; A. B. COMSTOCK, Nature Study.

Instructors: A. C. STRYKE; J. T. LLOYD.

Students are offered opportunity for advanced work in one or more of the following subjects: morphology of insects, embryology of insects, insect ecology, systematic and economic entomology, limnology, and nature study.

Each of the laboratories is well supplied with microscopes and other apparatus necessary for the special work carried on in it. The laboratory of morphology and embryology is especially equipped for histological work. Connected with the laboratory of systematic entomology there is a museum which contains, in addition to many exotic insects, specimens of a large proportion of the more

common species of the United States. These have been determined by specialists, and are accessible for comparison. The collection includes many sets of specimens illustrative of the metamorphoses and habits of insects. There is also in the museum a good series of invertebrates other than insects. The advanced work in economic entomology is carried on in large part in an insectary, a separate building; a second insectary adjacent to the laboratories is available for other phases of the work. A biological field station at the head of Cayuga Lake, one mile from the Campus and open throughout the year, and a hatching station in Cascadilla Gorge on the Campus afford exceptional opportunities for investigations in the biology of freshwater organisms.

The special library is rich in works on entomology and contains complete sets of all the more important entomological journals.

General Biology: General Entomology; Elementary Morphology of Insects; Elementary Systematic Entomology.

The courses above, or their equivalents, are prerequisite to graduate study.

Research in Limnology. Professor NEEDHAM.

Research in Morphology of Insects. Professor RILEY.

Research in Systematic Entomology. Assistant Professor BRADLEY.

Research in Economic Entomology. Professor HERRICK.

Advanced Systematic Entomology. Assistant Professor BRADLEY.

Histology of Insects. Professor RILEY.

Advanced Economic Entomology and Insectary Methods. Professor HERRICK.

Classification of the Coccidae. Assistant Professor BRADLEY.

Morphology and Classification of the Arachnida. Miss STRYKE.

Morphology and Development of Insects. Professor RILEY.

Entomology. Assistant Professor BRADLEY.

German Entomological Reading. Professor RILEY.

French Entomological Reading. Miss STRYKE.

Elementary Economic Entomology. Professor HERRICK.

Literature of Systematic Entomology. Assistant Professor BRADLEY.

General Limnology. Professor NEEDHAM and Mr. LLOYD.

Animal Parasites and Parasitism. Professor RILEY.

The Relations of Insects to Disease. Professor RILEY.

The Classification of Immature Insects. Assistant Professor BRADLEY.

Aquatic Nematoceros Diptera. Assistant Professor JOHANNSEN.

Aquiculture. Assistant Professor EMBODY.

Forest Insects. Professor HERRICK.

Nature Study. Assistant Professor COMSTOCK.

Nature Study Seminary. Professor NEEDHAM and Assistant Professor COMSTOCK.

HISTOLOGY AND EMBRYOLOGY

Professor: B. F. KINGSBURY.

Instructor: J. A. BADERTSCHER.

The equipment for this subject comprises a supply of modern microscopes, camera lucidas, polariscopes, microspectroscopes, photomicrographic cameras, and other special apparatus, in sufficient number to give each student opportunity for learning to use them, and for applying them to any special study in which they are needed. Two projection microscopes are available for blotting paper and wax plate reconstructions. The general and research laboratories are large and are equipped with microtomes, incubators, aquaria, etc. The collection of specimens is large and constantly increasing, and comprises preserved material and embryos as well as embryological and histological series of microscopic preparations of man and mammals and the lower vertebrates.

In addition to the general laboratory, preparation room, and private laboratory rooms for the staff, there is for this subject a large and well lighted advanced laboratory with three small rooms for individual workers, a photomicrographic laboratory and dark room, and a drawing and projection room. A museum of embryological models occupies the center of the advanced laboratory. The rich and varied fauna of the Cayuga Lake region affords favorable opportunity for investigations in the histology and embryology of all the main groups of vertebrates; material for the study of the development of the sheep, cow, and pig, is also available. Advanced work in histology and embryology is of necessity individual and is abundantly provided for. In addition advanced students are sometimes recommended to take some one or more of the general courses in the subject. As preliminary to graduate work, students are expected to have had the courses in the tissues and one of the following: the organs, special histology, embryology, the nervous system and organs of special sense. A year's work in zoology, biology, or physiology may with advantage be combined with advanced work in this subject.

The Tissues; the Organs; Embryology; the Nervous System and Organs of Special Sense.

Advanced Work in Histology and Embryology. Professor KINGSBURY and instructors.

Seminary in Histology and Embryology.

PHYSIOLOGY AND BIOCHEMISTRY

Professors: SUTHERLAND SIMPSON; ANDREW HUNTER; MELVIN DRESBACH.

Instructors: A. E. LIVINGSTON; M. H. GIVENS.

For advanced and graduate work in experimental physiology two large laboratories and several smaller rooms are available. Laboratory A on the first floor of Stimson Hall is provided with electro-motor-driven shafting and Sherrington recording drums of the most recent pattern, capable of giving wide ranges of speed. All necessary apparatus is available for graphic work in muscle and nerve physiology, for the investigation of problems in connection with the circulatory and respiratory systems, where objective records are desirable (for example,

movements of the excised amphibian and mammalian heart), and for the experimental study of the special senses and the central nervous system. Pendulum and spring myographs are available and several forms of ergograph for the study of muscular and nervous fatigue. Each table is supplied with chronographs and time-recording tuning-forks, induction machines, keys, switches, commutators, etc. Adjoining this laboratory are two smaller rooms; one is being equipped for experimental work on animal heat and body temperature, the other contains a Ludwig kymograph with accessories, and is used primarily for experimental pharmacology. There is also a dark room for photographic and optical work.

Laboratory B is devoted exclusively to research. The equipment includes hæmomanometers and blood-pressure apparatus of the most recent type, and a large Brodie kymograph for continuous smoked paper. A time-recording clock and artificial respiration and chloroform apparatus have just been added. Plethysmographs for recording volume changes in the various bodily organs are provided, and several clock-driven drums are available.

In connection with this laboratory there is a workshop with a skilled mechanic who is capable of making and modifying any kind of apparatus which may be required for special research.

In the basement, on a solid concrete floor, a room is being equipped with galvanometers, capillary electrometers, shunts, rheocords, bridges, and all the other apparatus required in electrophysiology.

The biochemical laboratories on the second floor of Stimson Hall include a general laboratory, and a smaller laboratory for research, both fitted throughout with water, gas, suction pumps, and draught cupboards. Adjoining these are a room for metabolic work, a balance room, a constant temperature room, and storerooms for chemicals and apparatus.

The equipment, which is being steadily increased along many special lines, is suited to the investigation of problems connected with the chemistry and functions of the animal body, and includes, besides a stock of glass apparatus and the ordinary fittings of a chemical laboratory, several metabolism cages, large and small balances, polarimeter, large centrifuge, Buchner press, incubators, and a selection of the most important works of reference. The principal periodicals dealing with physiology and biochemistry are also kept in the building.

Some problem demanding original investigation will be prescribed for each student, who will be guided in his choice of a subject by one of the professors in charge, due consideration being given to his previous training and to the line of work in which he desires to specialize. Having selected a subject, he will be expected to concentrate his efforts upon it. While the work will be done under the supervision of some one of the members of the teaching staff, and every facility provided in the way of apparatus, etc., the student will be encouraged to rely on his own resources as far as possible, especially in planning and carrying out his experiments. Any special apparatus which he may require or which he may himself design, will be made for him by the laboratory mechanic. It is expected that the results of his work will be embodied in a thesis, and if this is judged to be of sufficient merit it will be published in full or in abstract in some accredited scientific journal.

In addition to this specialized work, in order to give breadth of view, a course of reading will be assigned from time to time. This will be supplemented periodi-

cally by a colloquium, at which the current literature will be reviewed, and original papers presented for discussion.

Physiology of the Cell, Muscle, Nerve, Heart and Circulation, Blood and Lymph, and Respiration; Physiology of Digestion, Excretion, Internal Secretion, Animal Heat and Reproduction; Elementary Human Physiology; Experimental Physiology; Laboratory Work in Physiology; Elementary Biochemistry; General Biochemistry; Practical Biochemistry.

Physiology of the Nervous System and Special Senses.

Special Chapters in Biochemistry.

Advanced Work and Research in Physiology.

Advanced Work and Research in Biochemistry.

Seminary in Physiology and Biochemistry.

ANATOMY

Professor: A. T. KERR.

The laboratories for this subject are situated on the third floor of Stimson Hall and are admirably lighted and thoroughly ventilated. For gross dissection there is a large general laboratory, and adjoining the dissecting room is a smaller laboratory for special work, fitted with a hood and other facilities for digestion, maceration, and the making of corrosion specimens. At the end of the main dissecting room is another laboratory for topographical and regional dissection; also a large dark room with a projection outfit and facilities for drawing sections for making reconstructions. Upon this floor is also situated a dark room with a complete outfit for taking photographs of special preparations for illustrating research. In the basement is a compressed air apparatus for embalming and making special injections.

There is an abundance of anatomical material, which is embalmed and kept in cold storage so as to be ready for use when needed. The refrigerating apparatus is also used for freezing specimens for sections. In addition to the undissected material, there is an ample supply of special parts, such as bones, brains, the various abdominal and thoracic organs, special sense organs, etc.

The equipment includes dissecting microscopes, glassware, reagents, and other necessities of an anatomical laboratory.

In connection with histology and embryology, every facility is offered for studying anatomical problems from both the gross and the developmental points of view.

In the library are to be found complete series of practically all of the important periodicals dealing with anatomy, and the proceedings and transactions of the learned societies. In addition, the library is well supplied with the most important anatomical monographs and books.

Graduate work in anatomy should be preceded by courses in general biology and comparative anatomy. A reading knowledge of German and French is essential for the most successful research in anatomy.

Anatomy; Dissection of the upper extremity; Dissection of the head and neck; Dissection of the thorax; Thoracic and abdominal viscera, section demon-

strations; Dissection of the lower extremity; Dissection of the abdominal and pelvic walls and viscera.

Central Nervous System, Gross Anatomy. Laboratory work with occasional demonstrations. Professor KERR.

Anatomy. Advanced work and research. Professor KERR.

Anatomy of the Live Body. Assistant Professor ———.

Detailed topographical dissection and study of any region. Professor KERR.

Dissection of the entire human body. Professor KERR.

THE MEDICAL SCIENCES

As Presented in the Medical College in New York City

For a full description of the work in the Medical College at Ithaca and in New York City, see the Announcement of the Medical College.

The Medical College in New York City comprises the main building on First Avenue opposite to Bellevue Hospital and the adjacent Loomis Laboratory on Twenty-sixth Street.

The Main Building occupies the entire block between Twenty-seventh and Twenty-eighth Streets on First Avenue, extending back one hundred feet, thus affording an available space of nearly 20,000 square feet on each of its seven floors.

The Department of Anatomy occupies the entire fifth floor. In addition to a commodious and well lighted dissecting room there are numerous smaller rooms for investigation and research in anatomy, histology, and embryology, preparation rooms, storage rooms, etc.

The fourth floor is devoted entirely to pathology and bacteriology. There are several rooms for investigators and assistants, preparation rooms, classrooms, a teaching museum, and a library containing current numbers and many back files of the important journals devoted to medical science, in English, French, and German.

The facilities afforded by the departmental libraries in the medical school are readily amplified by use of the various libraries in New York City, several of which are within easy reach of the college buildings. Among these the library of the New York Academy of Medicine, the second largest medical library in the country, is worthy of special mention.

The Departments of Physiology and Chemistry occupy the third floor of the main College building and are equipped with laboratories devoted to the problems of research, in addition to those used by students in the course leading to the M.D. degree. Organic chemistry, physiological chemistry, and chemical pathology are thus specially provided for. One large room is set aside for calorimetry, and another has been equipped as an operating room in connection with the work in experimental physiology.

The lower floors of the main building contain the college offices, the dispensary, lecture rooms, class rooms, and a power plant.

The Loomis Laboratory, besides the pharmacological laboratories for medical students, contains laboratories for research in bacteriology, physiological chemistry, experimental medicine, and pharmacology. Facilities are thus furnished

to graduates who may desire to pursue further study or research in the various departments of laboratory investigation.

The second floor of this laboratory is devoted entirely to pharmacology and its allied sciences; the first and third floors provide accommodations for the Department of Experimental Therapeutics with research laboratories for physiological chemistry and chemical pathology. The fourth and fifth floors are devoted to research in pathology, bacteriology, and hematology; they also provide ample accommodations for photomicrography.

Bellevue Hospital, whose gates open directly opposite the college buildings, furnishes ample opportunity for extending the problems of the laboratory to the bedside, besides offering many intricate problems for solution in the laboratory.

The Hospital is organized in four divisions, one of which has, by the Trustees of the Hospital, been placed at the disposal of the Faculty of the Cornell University Medical College for medical research and instruction. The services thus intrusted to the College include, continuously, ninety medical beds, ninety surgical beds, thirty-two beds devoted to gynecology, twenty-two to genito-urinary diseases, and for one-half the year fifty-four obstetrical beds, together with equal privileges with the other three divisions, giving continuous opportunity for instruction and research, in the wards devoted to the treatment of alcoholic diseases, tuberculosis, and the psychopathic diseases.

New York Hospital.—The Medical College, through the courtesy of the Governors of the New York Hospital, has long been accorded certain privileges for instruction in its wards, but on the first of January, 1913, a definite arrangement was established between Cornell University and the New York Hospital, through the donation to the hospital of a generous fund which was presented by Mr. George F. Baker, one of the Governors of the Hospital, upon the condition that hereafter half the entire medical, surgical and pathological services of the institution should be definitely assigned to the Cornell University Medical College for the advancement of its teaching and research.

By this most advantageous arrangement the University nominates the Visiting Staff and Laboratory Staff of its division and secures the admission of its students to the wards as clinical clerks, which enables the College to make a definite provision in its courses of instruction and research for work in the New York Hospital, and this is now closely correlated in the curriculum with the similar work which has hitherto been done in Bellevue Hospital. Furthermore, the Laboratory Staffs of the different departments of the Medical College are placed at the service of the Hospital for the purpose of extending its scientific work. The hospital service thus assigned to the College comprises 100 beds. This service is exceedingly active. It includes several thousand acute and emergency cases brought in annually from a large ambulance and dispensary district. During the past year the New York Hospital extended treatment to 5,609 ward patients, about 2,000 of which afforded operative surgical cases.

The services thus supplied to the College are ample for advanced research as well as for undergraduate instruction.

ANATOMY (New York City)

Professors: C. R. STOCKARD; I. S. HAYNES; I. STRAUSS.

Instructors: W. M. BALDWIN; M. T. BURROWS; J. F. GUDERNATSCH; J. F. McCLENDON.

Abundant material and sufficient apparatus are available for advanced study and work in the various branches of anatomy, embryology, histology, comparative morphology, descriptive anatomy, and experimental anatomy. Students desiring to pursue graduate work in any of these branches must have had in their college courses preliminary training in general zoology and comparative anatomy. A reading knowledge of German and French is essential.

The laboratories are well equipped with microscopes, projection apparatus, microtomes, thermostats, etc., for advanced anatomical work. There is a good aquarium which makes it possible to conduct experimental studies on lower vertebrates.

New York offers exceptional advantages for obtaining fresh human material. The large slaughter houses are accessible for comparative mammalian tissues and organs. The extensive collections of specimens and models in the city museums are extremely helpful and instructive to the advanced student.

The members of the staff offer courses in the various phases of anatomy in which they are especially engaged. The courses offered for the medical students appear in the Medical College announcements and are particularly recommended to those students who have not pursued work of this kind. Technical and practical anatomical work are fully provided.

Morphology; Embryology; Histological Technic; General Histology; Microscopic Anatomy and Organology; Descriptive Anatomy including courses in dissection of the upper extremity, the head and neck, the lower extremity, the thorax, the abdomen and pelvis; Demonstrations on the Cadaver; Live Anatomy; Dissection Review; Topographical Anatomy; Neuro-Anatomy and Neuro-Histology; Applied Anatomy; Organs of Special Sense.

Anatomy of the Living Body. Dr. BALDWIN.

Special and Topographical Studies of Different Regions. Professor STOCKARD and Dr. BALDWIN.

Human Histology and Histogenesis. Drs. GUDERNATSCH and BURROWS.

Comparative Embryology. Professor STOCKARD and Dr. GUDERNATSCH.

Experimental Morphology. Professor STOCKARD and Drs. GUDERNATSCH, BALDWIN and BURROWS.

Anatomy of the Infant and Postnatal Development. Professor STOCKARD and Dr. BALDWIN.

PHYSIOLOGY (New York City)

Professors: GRAHAM LUSK; J. R. MURLIN; C. J. WIGGERS.

The physiological laboratory contains rooms furnished with modern apparatus for research in physical physiology, an operating room for aseptic surgical operations on animals, a chemical laboratory principally devoted to researches in metabolism, and a calorimetry room in which there is an Atwater-Rosa respira-

tion calorimeter of small size, adapted for work on children, dwarfs, and dogs. It is also equipped for work in general physiology. The laboratory is open to workers under certain restrictions at all hours of the day and night.

Appropriate minor subjects for students whose major subject is not in physiology, include nutrition with laboratory work, physiology of the respiration and circulation, and general physiology, including physiology of the cell and physiology of reproduction, and physiology of the nervous system.

The library of Professor Lusk, together with a large collection of reprints of articles by various authors, may be freely used by students.

Required preliminary work, courses in anatomy and chemistry, including organic chemistry. Physiological chemistry is desirable.

Blood and Circulation; Secretion; Respiration; Nutrition; Metabolism; the Nervous System; Special Senses; Psychic Relations; Seminary.

Physiology of Nutrition.

Respiration and Circulation.

General Physiology, including Physiology of the Cell and of Reproduction.

Physiology of the Nervous System.

PHYSIOLOGICAL CHEMISTRY AND CHEMICAL PATHOLOGY

(New York City)

Professor: S. R. BENEDICT.

Instructors: J. C. BÖCK, E. OSTERBERG.

The laboratories available for advanced work and research in physiological chemistry and chemical pathology include those of the Department of Chemistry, located in the main college building, the laboratory of chemical pathology at the Loomis Laboratory building, the new chemical laboratories at Bellevue Hospital, and a research laboratory in the General Memorial Hospital. These laboratories provide adequate equipment and abundant material for investigation in a great variety of special problems in the chemistry of the plant, animal or human organism in health or disease, by chemical, physical, or optical methods. In the college library the principal journals relating to these subjects are on file.

Students expecting to pursue investigation in physiological chemistry or chemical pathology should have adequate preliminary training in inorganic, analytical, and organic chemistry, as well as in physics, physiology, and physical chemistry, though a study of these latter subjects could be pursued at the College together with more advanced work in special lines.

Qualitative Analysis.

Quantitative Analysis.

Elementary Physics.

Organic and Physiological Chemistry; Research.

Physiological Chemistry.

Chemical Pathology.

PATHOLOGY (New York City)

Professors: JAMES EWING; W. J. ELSE; O. H. SCHULTZE; M. G. SCHLAPP;
J. C. TORREY.

Instructors: W. H. TYLER; F. M. HUNTOON; A. F. COCA; E. S. L'ESPERANCE.

The laboratories of pathology occupy the fourth floor of the main buildings and the third and fourth floors of the Loomis Laboratory. The equipment includes all the means commonly employed in pathological research and much new and original apparatus. Both laboratories are provided with suitable quarters for the care of animals. The departmental library includes about 6,000 bound volumes and a large and valuable collection of monographs and reprints. There is an extensive collection of specimens illustrating pathological histology, much material for histological study, and a museum containing about 1,200 specimens. The recent material from several hospitals is constantly available for study, and furnishes a supply of problems in many fields which is practically inexhaustible. Applicants who have been admitted to the Graduate School are urged to present the degree of Doctor of Medicine for admission to these courses. A limited number of fellowships is available in this department.

General Pathology; Special Pathology; Pathological Anatomy; Medico-legal Pathology; Autopsy Techniques; Experimental Pathology; Bacteriology.

General Pathology.

Special Pathology.

Bacteriology.

Immunology.

Preventive Medicine and Hygiene.

EXPERIMENTAL THERAPEUTICS (New York City)

Professors: S. P. BEEBE; R. WEIL.

Instructor: R. A. COOKE; E. VAN N. VAN ALSTYNE.

The laboratories of experimental therapeutics, located in the Loomis Laboratory, include modern facilities and equipment for the study of biochemistry, experimental physiology, bacteriology, immunity, and experimental pathology. The experimental work done by the Huntington Fund for Cancer Research has, in large part, been carried on in these laboratories during the last eight years.

Whenever a problem demands the study of particular diseased conditions in human patients, the rich material afforded in the wards of Bellevue Hospital can be made available.

It is expected that a student who presents himself for work in this subject will have already completed in a satisfactory manner the preparatory courses in science, which will fit him to begin immediately the study of some special problem. No didactic instruction is given; the student must be prepared for research before entering. A seminary is held each week at which the attendance of all the instructors and students engaged in research is required.

Biochemistry.

Experimental Physiology.

Immunity and Experimental Pathology, in their relation to Experimental Therapeutics.

PHARMACOLOGY (New York City)

Professor: R. A. HATCHER.

Instructor: C. EGGLESTON.

The laboratory of pharmacology, in the Loomis Laboratory, is well equipped for general work and research in pharmacology, and special opportunities will be afforded for doing work involving the action of drugs on the circulatory system, and methods of biological testing of drugs and medicines, either supplementing or replacing chemical tests for activity and identity.

The departmental library is sufficient for the immediate needs of workers, and its facilities are readily amplified by the College and other libraries near by which furnish every opportunity for extending the work.

Materia Medica and Pharmacy; Advanced Pharmacy; Pharmacology.

Research in the Pharmacodynamics of Drugs; Toxicology.

COMPARATIVE PATHOLOGY AND BACTERIOLOGY

Professors: V. A. MOORE; S. H. BURNETT; C. P. FITCH.

Instructor: E. M. PICKENS.

The laboratories in comparative pathology and bacteriology are well equipped for research in general pathology, the pathology of infectious diseases, and for bacteriological work especially in connection with animal bacterial flora, pathogenic organisms, and problems associated with the morphology and physiology of bacteria and their products. The library facilities are good.

Candidates for advanced degrees taking their major subject in pathology or bacteriology should have had courses in general pathology or in bacteriology equivalent to the corresponding courses given in this department. Candidates electing a minor subject in this department may take the courses in general pathology and in bacteriology.

General Pathology; Special Pathology and Meat Inspection; Pathology of Infectious Diseases; Bacteriology; Parasites.

Research in Bacteriology and Pathology.

Laboratory Methods of Diagnosis.

Advanced Bacteriology.

Clinical Examination of the Blood.

VETERINARY PHYSIOLOGY

Professor: P. A. FISH.

Instructor: C. E. HAYDEN.

The department has a good equipment for the study of physiologic problems in connection with the domesticated animals. The laboratories, located in the Veterinary College, are ample and are provided with modern apparatus for such research as can best be conducted in the laboratories. In the same building

there is a well assorted collection of recent books and periodicals on comparative physiology, which may be supplemented by the many works on general physiology in the University Library.

The Veterinary Experiment Station, controlled by the College, and not far distant can be utilized for field observations and the study of those problems outside of the scope of the laboratory. This unusual combination of field and laboratory research should be conducive to important results.

As a preparation and aid in this research, attendance at the general lecture and laboratory courses in veterinary physiology is recommended.

Physiology Recitations; the Physiology of the Nutrition and Secretion of the Domesticated Animals; the Physiology of the Muscular and Nervous Systems; Physiological Laboratory; Course in Urine Analysis.

Advanced Physiology. Professor FISH and Mr. HAYDEN.

SOIL TECHNOLOGY

Professors: T. L. LYON; E. O. FIPPIN; J. A. BIZZELL; H. O. BUCKMAN.

A graduate student who desires to make soil technology his major subject should have had sufficient training in inorganic or biological chemistry or in bacteriology to give him a command of the technique as well as of the principles of the subject. It is also desirable that he should have had enough technical agriculture to enable him to see the agricultural bearing of the work.

The facilities for graduate study in this subject may be divided into two groups: first, those of the research laboratory; and second, those of the teaching laboratory.

The research laboratory is primarily concerned with investigation and is open, except in unusual cases, only to graduate students who are working upon their major subjects.

The laboratory is planned for chemical, bacteriological, and physical investigations of soil. The object has been so to equip it that a soil problem may be attacked through any of the known means of soil study. The usual facilities for the chemical analyses of soils and plants are at hand, and permit the determination of all of the constituents of the soil concerned in plant nutrition. For bacteriological work the laboratory contains in its equipment an autoclav of the largest size, sterilizers, incubators for different temperatures; and for mechanical analyses a centrifuge, a shaking machine, and other necessary apparatus. Two greenhouses provide opportunity for conducting crop tests of soils during the winter, and for experiments with nutrient solutions and sand cultures. A field for plat experiments gives ample facility for work on a larger scale. In this field a series of large concrete tanks each holding between three and four tons of soil has recently been built. Pipes from these tanks carry the drainage water into a tunnel where is it collected for measurement and analysis. These varied and extensive facilities afford opportunity for students trained in any one or more of several sciences to investigate soil or plant nutrition problems.

The general laboratory is equipped with many types of apparatus for soil study, including centrifugal apparatus for mechanical analyses, constant tempera-

ture ovens, aspirators, titration apparatus, pressure filter pumps, etc. There are in addition several hundred samples of soil from all parts of the United States for comparison and classification. All the soil maps of the United States arranged in form for ready reference, and all the literature relating to the various phases of soil study to be found in the departmental and university library collections are available. The laboratories are supplemented by extensive field plats, and the university farm is used for the investigation of many problems which require that type of equipment.

A graduate student who desires to take a minor subject in this department will be expected to take the regular courses offered in the department unless he has already had their equivalent, in which case other work will be given him. (See Announcement of the New York State College of Agriculture.)

Students who are expecting to take graduate work in soil technology are advised to write to some member of the instructing staff for information.

Principles of Soil Management. Assistant Professor BUCKMAN.

Soil Surveying. Assistant Professor BUCKMAN.

Advanced Soil Lectures. Professor BIZZELL.

Manures and Fertilizers. Assistant Professor BUCKMAN.

Research in Soils. Professors LYON and BIZZELL.

Soils Seminary. Professors LYON, FIPPIN, BIZZELL and Assistant Professor BUCKMAN.

RURAL ECONOMY

Professor: G. N. LAUMAN.

It is not expected that all students of the subject will have a general knowledge of scientific agriculture in addition to training in economics and history; but for those who expect to specialize in this subject, a knowledge of the technical side of agriculture is strongly recommended. Many problems, however, may be successfully studied without the more technical training.

The library collections, general and departmental, are unusually complete. Much attention has been given to collecting the literature dealing with the economic and social conditions of agriculture in Western Europe. The literature of the technical side of agriculture, containing as it does a wealth of data as yet little used, is available in considerable completeness.

As many non-technical rural problems are best studied by actual contact with the population, the close relations maintained by the College of Agriculture in its extension work may be made an important aid to the student.

Agriculture.

Rural Economy.

Rural Social Conditions.

History of Agriculture.

Conservation.

Co-operation.

Investigation.

FARM MANAGEMENT

Professors: G. F. WARREN; K. C. LIVERMORE.

Instructors: A. L. THOMPSON; D. S. FOX.

Admission as a graduate student does not necessarily admit to graduate work in this department. For major work, only those persons who have spent several years in farm work and whose training in other respects is satisfactory to the department will be accepted as graduate students.

Since the satisfactory completion of an investigation in farm management ordinarily takes more than one year, students who can spend but one year are recommended to take a minor rather than a major in this department.

Cost Accounting. Mr. THOMPSON.

Farm Management. Professors WARREN, and LIVERMORE, and Messrs. THOMPSON and FOX.

Advanced Farm Management. Professor LIVERMORE.

Seminary. Professors WARREN and LIVERMORE, and Messrs. THOMPSON and FOX.

FARM CROPS

Professor: E. G. MONTGOMERY.

Instructor: E. V. HARDENBURG.

Before undertaking graduate work in farm crops, the student should have had a general scientific training (six hours in botany, ten hours in chemistry, four hours in geology, and six hours in physics), equivalent to courses in Cornell University, as well as at least five hours of university work in soils and crops.

Cereals, Forage Crops and Miscellaneous Crops; Cereal Crops; Forage Crops; Potatoes, Beans and Special Crops.

Research. Professor MONTGOMERY.

Seminary. Professor MONTGOMERY.

RURAL ENGINEERING

Professors: H. W. RILEY; B. B. ROBB.

Instructors: N. D. STEVE; L. E. HAZEN; J. L. STRAHAN.

The laboratory equipment for mechanics consisting of gasoline engines, spray machinery, pumps, hydraulic rams, water supply systems, steam engine, steam injectors, grain binders, separate binder attachments, plows, separate plow bottoms, and other apparatus of similar nature, is selected primarily for teaching the elements of applied mechanics.

A limited amount of laboratory space is available through the winter for research; more room can be provided for summer work. The apparatus now on hand for advanced work consists of a Schaeffer and Budenburg recording traction dynamometer and the Cornell Sprayograph, a power-driven focal plane or curtain shutter for testing the performance of spray nozzles, the records taken being fifty-two inches square. A limited amount of additional special apparatus each year as required for particular investigations may be designed and built,

or bought, without expense to the student. Because of limited storage space very little bulky machinery is retained through the winter but loans of implements of any kind are easily secured for investigations through the summer.

The preparation required of candidates for advanced degrees in mechanics will vary somewhat with the character of the thesis subject. For problems involving the design of new machines or implements or the comparison of existing ones, there will be required a good working knowledge of mechanical drawing, kinematics, mechanics, and machine design, in addition to an adequate understanding of the purely agricultural features of the work. For problems involving the study of the economic value of certain types of implements, less stress will be laid on engineering preparation and more upon that in farm crops, farm management, and rural economy. Practical farm experience is of almost vital importance for any work in this department. Students deficient in engineering subjects may take necessary work in Sibley College; deficiencies in agricultural subjects may be made up in the College of Agriculture.

The department's equipment for farm engineering consists of eight inexpensive farm levels for use in the elementary course; and for advanced work, an architect's wye level and light engineer's transit for men not well versed in instrument work; while for men competent to use them, there is a fine engineer's transit and a precision dumpy level. In addition, the necessary tapes, pins, axes, and leveling and stadia rods are provided.

The preparation necessary for advanced work in farm engineering, as in mechanics, will vary with the thesis subject. In general there will be required a good knowledge of trigonometry, surveying, physics, soils, farm crops, and general agricultural practices and conditions.

Exceptional opportunities for working out actual problems in this line are afforded by the extension work among farmers of the State, which includes the solution of the engineering problems involved in mapping farms or in laying out the drainage of areas, varying from one field to entire drainage districts.

Farm Mechanics; Dairy Mechanics; Farm Engineering; Drainage and Irrigation; Farm Structures.

Research in Farm Mechanics. Professor RILEY.

Advanced work in Farm Engineering. Assistant Professor ROBB.

FORESTRY

Professors: WALTER MULFORD; S. N. SPRING; A. B. RECKNAGEL; F. B. MOODY; JOHN BENTLEY, JR.

Students who wish to elect their major or a minor subject in forestry, either for a Master's degree or for a Doctor's degree, are offered opportunity for advanced study or research in silviculture, forest management, forest mensuration, and forest policy.

A professional forestry course is offered. This course requires five years and leads to the degree of Bachelor of Science at the end of the fourth year, and to the degree of Master in Forestry at the end of the fifth year. Students who enter as graduates without having had undergraduate instruction in forestry

should be able to complete the work for the Master's degree in two years, if they have had substantially the equivalent of most of the courses, other than forestry, listed in the recommended sequence of courses for the first four years of the professional work. If they lack much of the fundamental science work there listed, it will require a correspondingly longer time to get the Master's degree. This sequence of courses, and other details regarding the professional work, are given in the Announcement of the Department of Forestry, which may be obtained from that department. Prospective forestry students should provide themselves with this announcement, and should write to the Department of Forestry for general information regarding the course of study which they would need to pursue.

A forestry building, for which \$120,000 was appropriated by the State, will be in use before the beginning of the year 1914-15. The building provides ample laboratory facilities for advanced study and research. The department has eight woodlots on the University farms, including stands of white pine, hardwoods, and hemlock; it has also a farm of thirty-eight acres, part of which is open land used for experimental plantations, the remainder being wooded. All these lands are within two miles of the University Campus. Three miles from the Campus the department has 175 acres of open land, which is being used for experimental and demonstration plantations. A forest nursery has been established. There is a good forestry library, including extensive files of forestry periodicals; and an ample collection of forestry instruments. The vicinity of Ithaca offers excellent opportunities for field studies in several types of forest.

The Farm Woodlot; Elements of Forestry; Mensuration, Utilization and Management; Elements of Forestry; Silviculture; The Field of Forestry.

Wood Technology. Professor RECKNAGEL.

Forest Utilization. Professor RECKNAGEL.

Forest Engineering. Assistant Professor BENTLEY.

Forest Mensuration. Assistant Professor BENTLEY.

Timber Trees and Forest Regions. Assistant Professor BENTLEY.

Silviculture: Forest Ecology. Professor MULFORD.

Silviculture: Natural Reproduction and Care of the Forest. Professor MULFORD.

Silviculture: Forest Planting and the Forest Nursery. Professor SPRING.

Forest Protection. Professor SPRING.

Forest Policy, Forest Law, and History of Forestry. Professor SPRING.

Forest Management. Professor RECKNAGEL.

Forest Administration. Professor RECKNAGEL.

Advanced Work and Research. Professors MULFORD, SPRING, RECKNAGEL, and MOODY, and Assistant Professor BENTLEY.

Seminary.

LANDSCAPE ART

Professors: BRYANT FLEMING; E. GORTON DAVIS; RALPH W. CURTIS.

Instructor: E. D. MONTILLON.

Graduate work is offered in general landscape design, civic and town planning, rural landscape development, garden design and ornamentation, planting design, history of landscape design and landscape engineering.

Candidates for the degree of Master in Landscape Design must be graduates of colleges of equal standing with the New York State College of Agriculture, and must have completed a course substantially equivalent to that offered by the Department of Landscape Design, and leading to the Bachelor of Science degree of this college.

This department is well equipped for graduate work as to space and convenient drafting facilities. It is also provided with a well chosen reference library containing the best and more important literature, both early and modern; collections of photographs of the best examples of landscape work in this and other countries; and of plans and drawings, examples of the technique of drawing and expression, and of the better work of representative practicing landscape designers, illustrating their solutions of various types of landscape problems. A large collection of lantern slides supplements all lecture courses and the same illustrations are accessible for study in prints.

Advanced work in design and construction is also considerably broadened by opportunity for discussion with, and criticism from, well known visiting lecturers and critics.

The Appreciation of Landscape; History of Landscape Design; Theory and Aesthetics of Landscape Design; Plan Evolution; Elementary Landscape Design; Elements of Planting Design; Landscape Design; Landscape Engineering and Details of Construction; Planting Design; Seminary.

ANIMAL HUSBANDRY

Professors: H. H. WING; M. W. HARPER; E. S. SAVAGE.

Instructor: G. W. TAILBY, JR.

Among the herds and flocks belonging to the College of Agriculture may be mentioned the dairy herd of fifty cows, a stud of Percheron horses, a flock of about 150 sheep of various breeds, and a herd of breeding swine. The equipment for animal husbandry includes a very full collection of the herd and flock registries of all the breeds of domestic animals kept in this country, amounting to more than one thousand volumes, and affording excellent facilities for studies in heredity and genetics. Further work may be carried on in problems of animal nutrition based on investigation with the animals themselves.

Animal Husbandry; Meat and Milk Production; Practice in Feeding and Stable Management; The Horse; Mechanics of the Horse; Advanced Stock Judging; Principles and Practice of Feeding; Principles of Animal Breeding; Practical Horse Training; Dairy Cattle; Beef Cattle, Sheep, and Swine.

Advanced Course in the Principles of Breeding Animals. Professors WING and HARPER.

Advanced Course in the Principles of Feeding. Professors WING and SAVAGE.

Mechanics of the Horse. Professor HARPER.

POULTRY HUSBANDRY

Professors: J. E. RICE; C. A. ROGERS.

Instructors: E. W. BENJAMIN; O. B. KENT.

The equipment includes 1300 fowls with which to carry on feeding and breeding experiments, also appliances for investigation in incubation and brooding. The laboratory contains facilities for anatomical work. In addition to a very complete set of bulletins in the poultry library, assembled from the various experiment stations in the United States and Canada, numerous books on poultry husbandry are available in the University Library, the library of the College of Agriculture, and the special departmental library. The department is also provided with a topical card index, with cross references, of the principal poultry books, bulletins, and magazines; a large mass of data from research; and over four thousand negatives, a large number of which have to do with poultry investigations.

The new poultry husbandry building and equipment, costing approximately \$120,000 is now in use. It is expected that the new auxiliary buildings, costing \$25,000, will be ready for occupancy during the year 1914. This will furnish still further equipment and facilities for graduate work along many lines of instruction and research.

Owing to the fact that many of the colleges do not give the undergraduate courses in poultry husbandry which are prerequisite to graduate work in this subject here, very few students coming from other colleges can enter immediately upon graduate study. Most students will find it necessary to take a year of undergraduate courses before beginning graduate work.

Courses of instruction of an advanced nature may be taken along the lines of poultry feeding, breeding, marketing, house construction, and poultry farm management, and, in co-operation with the staff of the Veterinary College, in poultry disease investigations; in co-operation with the staff in agricultural chemistry, in incubation and nutrition investigations; and in co-operation with the staff in histology and embryology, in incubation experiments.

Poultry Husbandry; Feeding and Breeding; Incubator and Brooder Practice; Breeds and Judging; Poultry House Construction; Poultry Farm Management; Farm Poultry; Marketing; Poultry for the Household; Research; Seminary.

DAIRY INDUSTRY

Professors: W. A. STOCKING; H. E. ROSS; H. C. TROY; E. S. GUTHRIE; W. W. FISK.

Instructors: T. J. MCINERNEY; H. M. PICKERILL.

The different laboratories for this subject are well equipped with apparatus for special work and offer good opportunities to graduate students for research.

Before taking up graduate work in this subject, it is desirable that a student should have chemistry course 6, or its equivalent, and bacteriology course 4, or its equivalent, in addition to the elementary courses in the particular subject in which he wishes to do his graduate work.

A limited number of graduate students intending to fit themselves for teaching dairy industry may have an opportunity for work in instruction in the different laboratories during the winter courses.

It is expected that graduate students in dairy industry will attend the seminary in that subject.

Milk Composition and Tests; Butter Making; Cheese Making; Elementary Bacteriology; Dairy Mechanics; Market Milk and Milk Inspection; Fancy Cheese and Ice Cream; General Agricultural Bacteriology; Bacteriology for the Home; Dairying for the Farm Home.

Advanced Testing. Professor TROY.

Dairy Bacteriology. Professor STOCKING and Mr. PICKERILL.

Advanced Buttermaking. Professor GUTHRIE.

Advanced Cheddar-Cheese Making. Assistant Professor FISK.

Seminary. Professors STOCKING, ROSS, TROY, GUTHRIE, and Assistant Professor FISK.

Research. Professor STOCKING, ROSS, TROY, GUTHRIE, and Assistant Professor FISK.

MECHANICAL AND ELECTRICAL ENGINEERING

Graduate work is offered in the following subjects in the Sibley College of Mechanical Engineering and the Mechanic Arts. For a complete description of the equipment and the organization of this college see its special announcement, which may be obtained from the Secretary of the University.

Candidates for the degree of Master of Mechanical Engineering must have had preliminary training equivalent to that required at Cornell University for the degree of Mechanical Engineer.

Mechanics

Professors: E. H. WOOD; S. S. GARRETT; R. L. DAUGHERTY.

Instructors: W. R. CORNELL; R. B. DAY; D. R. FRANCIS; H. M. PARMLEY.

Hydraulic investigations along various lines can be carried on in this department. For experimental work there are available the equipment of the mechanical laboratory and the university hydro-electric power plant. This power plant contains a reaction turbine operating under 142 feet head and four impulse tur-

bines operating under 135 feet head. The reaction turbine is a 550 H. P. unit built by the I. P. Morris Co. It is direct connected to a 450 K. W. alternator. The impulse turbines consist of two 280 H. P. Pelton-Doble wheels driving 150 K. W. alternators, and two 50 H. P. Pelton-Doble wheels connected to 30 K. W. D. C. generators.

The libraries of the University have a very complete collection of treatises relating to mechanics, hydraulics, hydro-electric engineering, and to similar subjects. In addition, these libraries contain the more representative engineering periodicals and the transactions of the leading engineering societies of the world.

Mechanics of Engineering; Hydraulics; Hydraulic Turbines.

Machine Design and Construction

Professors: D. S. KIMBALL; G. R. McDERMOTT; H. D. HESS; C. D. ALBERT; L. D. HAYES; J. T. WILLIAMS; A. E. WELLS.

Instructors: C. B. BENNETT; L. J. BRADFORD; C. D. CORWIN; J. VAN DER DOES DE BYE; P. B. EATON; H. L. FREEMAN; E. F. GARNER; R. W. GRAHAM; C. W. HAM; T. O. HUSSEY; F. E. KLINCK; M. A. LEE; G. C. MILLS; C. E. TOWNSEND; H. H. WATERS.

There are eight well equipped drafting rooms. The Sibley College Library and the University Library have a very complete collection of books on machine design, drawing, construction, principles of manufacturing, industrial organization, and related subjects.

The shops are fully equipped throughout with standard hand and machine tools, selected with the view not only of giving manual instruction but also of illustrating modern manufacturing methods. The pattern shop has recently been completely re-equipped with new benches, lathes, and other power tools. The foundry contains five moulding machines of the various types and is equipped with a two-ton cupola, core ovens, crane, and overhead trolley, as well as with an ample supply of modern flasks and hand tools. The forge shop is equipped with twenty-eight standard forges and also contains a drop hammer, power shears, and punch press. The machine shop is equipped with twenty-five standard lathes for milling machines of various types, two shaping machines, one large radial drill press, two standard drill presses, one horizontal and one vertical boring mill, two semi-automatic lathes, one automatic lathe, two grinding machines, and one key-seater, as well as with an ample supply of hand tools.

Drawing; Descriptive Geometry; Machine Drawing; Kinematics; Machine Design; Elementary Design and Drawing; General Engineering Design; Advanced Design and Drawing; Structural Plant Engineering; Engineering Principles; Foundry Work; Forge Work; Pattern Making; Machine Work; Principles of Manufacturing; Industrial Organization.

Plant Engineering.

Ship Design.

Structure and Strength of Ships.

Resistance, Propulsion, and Powering of Ships.
Advanced Designing.
Advanced Industrial Organization.

Engineering Research

Professors: R. C. CARPENTER; W. M. SAWDON.

Instructor: L. A. WILSON.

Engineering research is under the charge of a separate corps of specialists who devote their entire time to this work and to giving advice and assistance to graduate and undergraduate students who are carrying on investigations in the various branches of mechanical engineering. Much of the work in this subject is conducted in the several laboratories described under Experimental Engineering. The equipment and resources of all other departments of Sibley College are likewise available, and in most instances arrangements can be made to use the equipment of the scientific and engineering departments of the other colleges of the University.

Motor Car Construction; Heating and Ventilating.

Engineering Research.

Power Plant Testing.

See also courses in Experimental Engineering.

Experimental Engineering

Professors: HERMAN DIEDERICH; G. B. UPTON; V. R. GAGE.

Instructors: E. S. BURNETT; D. S. COLE; W. J. DIEDERICH; C. V. ELLIOTT;
W. H. HOOK; F. E. KLINCK; P. G. McVETTY; W. R. WIGLEY; S. R. WING.

The Materials Testing Laboratory. This laboratory is equipped for tension and compression tests with an Olsen 300,000 pound machine, an Olsen 100,000 pound machine, a Riehle 100,000 pound machine, a 200,000 pound Emery hydraulic machine, together with several other machines varying in capacity from 10,000 to 100,000 pounds. For transverse tests there is a Riehle machine of 200,000 pounds capacity, and a Fairbanks machine of 10,000 pounds capacity. There are an Olsen torsion machine of 200,000 inch-pounds capacity, two Thurston autographic torsion machines, and an Upton-Lewis fatigue testing machine. The equipment includes measuring instruments, such as extensometers, a cathetometer, and other apparatus, such as gas furnaces, and tempering baths, required for the determination of the physical qualities of engineering materials under tensile, compressive, transverse, and torsional stress, and under different kinds of heat treatment.

The Steam Laboratory. In this laboratory there is a 150 H. P. triple expansion Allis-Corliss engine so fitted up that it may be run as a simple, compound, or triple engine, condensing or non-condensing. There are also several smaller engines, including a Russell, a Harris-Corliss, a Payne and a Wickes Bros. automatic engine. There are three surface condensers which may be connected with these engines as desired. There is one 35 kw horizontal Curtis turbine and one 15 kw De Laval turbine. These turbines drive electric generators and may be run condensing or non-condensing.

There is a two-stage steam-driven Ingersoll-Rand compressor, and three air-brake pumps of different types, together with meters, nozzles, and other instruments used in testing. This part of the laboratory also contains several fans, including one of the Sirocco type.

The equipment of apparatus and instruments used for engine testing comprises about 80 indicators of different types, about 75 steam gauges, a number of calorimeters for the determination of the quality of steam, speed counters, tachometers, planimeters, etc., besides a number of dynamometers of various kinds.

The boiler section of this laboratory has one 150 H. P. Babcock & Wilcox water-tube boiler of the marine type, and one 100 H. P. Babcock & Wilcox water-tube boiler of the standard type, both of which are fitted with internal superheaters. There are also one 80 H. P. Heine water-tube boiler and one 25 H. P. Roberts safety boiler connected with a Foster independent superheater. The auxiliary apparatus consists of a Cochrane open heater, a Wainwright closed heater, steam pumps, traps, injectors, etc. A full set of scales, measuring tanks, gauges, flue gas apparatus, separating and throttling calorimeters, pyrometers, etc., complete the boiler equipment.

The Gas Engine Laboratory. The equipment consists of an 8 H. P. Fairbanks gasoline engine, an 8 H. P. Olds gasoline engine, an 8 H. P. Hornsby-Akroyd oil engine, a 15 H. P. Hornsby-Akroyd oil engine, a 16 H. P. Acme gas engine run on producer gas from a 15 H. P. suction gas-producer, an 8 H. P. Ingeco oil engine, a 30 H. P. gasolene marine engine, and a 30 H. P. three cylinder Westinghouse gas engine with gas producer. The last engine may also be run with illuminating gas. Hot air engines are represented by a Rider and an Ericsson engine. The engine equipment is chosen to give as great a variety as possible in fuel used, types of governing, etc.

The supply of testing instruments includes several outside-spring indicators, optical indicators, and a manograph. For temperature measurements there are available high reading thermometers and pyrometers of the expansion and electrical types.

The Hydraulic Laboratory. This laboratory contains the following machines and apparatus: A 3-inch single-stage De Laval centrifugal pump; a 2½-inch two-stage Worthington centrifugal pump; a 12-inch Doble water wheel; several Pelton wheels and hydraulic rams; sets of weir boxes with various types of weirs and nozzles for the determination of coefficient of discharge; various types of water meters and other apparatus for measuring the flow of water, such as Pitot tubes, Venturi meters, current meters, etc.

The Oil Testing Laboratory. This laboratory contains a Cornell oil-testing machine, a Thurston standard railway testing machine, and several smaller Thurston machines. The rest of the equipment consists of several viscosimeters of different types, together with the necessary hydrometers and thermometers.

The Refrigeration Laboratory. For the study of refrigeration in all its phases, the mechanical laboratory possesses a very complete York refrigerating plant having a capacity of 15 tons of ice, besides a Brunswick and a De La Vergne machine of small size.

The Cement Laboratory. This laboratory not only contains the ordinary apparatus for the testing of cement and concrete but in addition is equipped with

crushing and grinding machinery and a small vertical kiln for making investigations in the manufacture of cement from raw material.

The Fuel Testing Laboratory. This laboratory contains a complete equipment of fuel calorimeters, and other apparatus needed for the determination of the composition and calorific value of fuel, whether gaseous, liquid, or solid.

Manufacture of Engineering Materials; Properties of Engineering Materials (laboratory); Introductory Experimental Engineering (laboratory); General Experimental Engineering (laboratory).

Power Engineering

Professors: A. W. SMITH; W. N. BARNARD; C. F. HIRSHFELD; F. O. ELLENWOOD; R. MATTHEWS.

Instructors: C. H. BERRY; R. E. CLARK; E. T. JONES; C. A. PEIRCE.

The graduate work conducted under this heading includes investigations in engineering thermodynamics, problems in power plant economics, the selection and arrangement of the equipment of power plants and the design of such equipment. The library is liberally provided with reference books, periodical literature and transactions of engineering societies, relating to these subjects.

Elementary Heat-Power Engineering; Power Plant Design and Economics; Steam Engine Design (lectures and drafting); Steam Turbine Design; Steam Boiler Design; Gas Machinery Design (lectures and drafting); Gas Manufacture and Distribution.

Designing and Special Problems in Heat-Power Engineering.

Electrical Engineering

Professors: V. KARAPETOFF; G. S. MACOMBER; W. S. FORD;

Instructors: W. C. BALLARD; A. G. BIERMA; C. G. BROWN; H. W. BROWN; W. G. CATLIN; R. F. CHAMBERLAIN; J. F. H. DOUGLAS; J. G. PERTSCH, Jr.; A. C. STEVENS; R. L. STEVENSON; F. G. TAPPAN.

The Lecture Equipment. In addition to the usual complement of apparatus for demonstration, the lecture equipment includes an air-insulated, high-pressure transformer, with necessary regulators for subjecting insulators and insulating material to alternating pressures up to 60,000 volts. This can be supplemented by additional transformers for raising the pressure still higher. A 30,000 volt transformer provides current for wireless telegraphy. All the standard equipment, as well as many pieces of specially designed apparatus, are employed to illustrate the operation of the principal laws applied in electrical engineering. Exhibits of apparatus such as street railway car controllers, rail sections, insulating and line material, etc., are provided in profusion. This list includes a complete outfit for exhibiting in actual operation the multiple-unit system of electric car control. An electric elevator and an overhead traveling crane system permit the laboratory motors and generators to be brought into the lecture room and class room for purposes of operation and illustration.

The Laboratories. The laboratory apparatus comprises a full complement of modern alternating and direct-current machinery of all kinds. The alternating-

current equipment includes single and polyphase alternators and synchronous motors, induction motors, transformers, and all apparatus auxiliary thereto. A variety of direct-current dynamos and motors suitably mounted for testing, covers the field of direct-current machinery. There is a large supply of ammeters, voltmeters, and wattmeters of all types and ranges. A De Laval steam turbine geared to a direct-current generator, a direct-connected marine set, circuit breakers, switches, water rheostats, and other auxiliaries are in use for plant test experiments. A 35 kw direct-connected turbo-generator is also available. The plant testing is done largely outside of the college buildings and for this purpose a large variety of ammeters, voltmeters, wattmeters, and other instruments is maintained in adjustment at a high standard of accuracy. These instruments have capacity great enough for testing the largest power plants. Special facilities are provided for the standardization of all electrical apparatus. Board of Trade and Reichsanstalt standards of resistance with large current-carrying capacity, potentiometers and galvanometers, and reference standards of electro-motive force are among the facilities provided for this purpose. In addition to the apparatus in the laboratories, the student may observe in operation a three-phase power transmission in the local power and lighting service. Large direct-connected generators, rotaries, constant current regulators, and induction motors, as well as the lighting system and railway system are convenient for inspection. The University has a modern hydro-electric plant containing large three-phase alternators direct-driven by Doble impulse water-wheels and by a reaction turbine. The power station also contains smaller units for direct-current supply with all necessary auxiliary apparatus.

Elementary Electrical Engineering; Theory of Electrical Machinery; Characteristics of Electrical Machinery; Electrical Laboratory; Design of Electrical Machinery; Generation and Distribution of Electrical Energy; Telephone and Telegraph Engineering; Electric Railway Practice; Electrical Illumination Engineering; Engineering Mathematics.

Theory of Electrical Machinery.
Characteristics of Electrical Machinery.
Design of Electrical Machinery.
Engineering Mathematics.
The Graduate Seminary in Electrical Engineering.

CIVIL ENGINEERING

Graduate work is offered in the following subjects in the College of Civil Engineering:

For a detailed description of the equipment and the organization of this college see its special announcement, which may be had on application to the Secretary of Cornell University.

Geodesy and Astronomy

Professors: O. M. LELAND, Geodesy and Astronomy; P. H. UNDERWOOD, Topographic and Geodetic Engineering.

Instructors: L. A. LAWRENCE; J. C. MCCURDY; C. M. BAKER; CARL CRANDALL.

The geodetic equipment is one of the most extensive in the country. The library facilities in this subject are also unusual, embracing the principal books relating to geodetic work in all parts of the world.

The Fuertes Observatory is a brick building eighty feet long. It contains a transit room with four piers; three domes, one of which supports an equatorial telescope, while the others are used for altazimuths; a clock room with piers for level trier and pendulum apparatus; two computing rooms; and an instrument room.

The metric laboratory for the comparison of standards of length is in the basement of Lincoln Hall and is especially constructed with double walls so as to have as nearly a constant temperature as practicable. It contains the four-meter comparator and a pier for gravity determinations.

The following outlines show various classes of work that may be undertaken in this subject and the character of the equipment.

Geodesy and Geodetic Methods. The works of Crandall, Clarke, Jordan, Helmert, and others may be used for special reading. The publications of the United States Coast and Geodetic Survey and of the International Geodetic Association are available for reference.

Geodetic Astronomy. Determinations of time, latitude, longitude, and azimuth are considered. Chauvenet's, Doolittle's, and Hayford's books on this subject may be used as texts.

In connection with the study of star positions, the library contains an assortment of the standard catalogues of stars and the publications of many of the leading observatories of the world. Direct observations may be made with the equatorial telescope of four and one-half inches aperture. This instrument is also suitable for observations of the positions of comets, the components of the easily separated double stars, etc., and the theoretical studies may include similar topics.

For the practical work at the Observatory, the equipment includes, besides the equatorial telescope, an astronomical transit by Troughton & Sims; a meridian telescope and two zenith telescopes by Fauth, one of the latter being adapted to photographic methods; altazimuths by Troughton & Sims and Fauth; a Howard mean-time clock; chronometers by Negus and Nardin; and surveyor's transits, sextants, and auxiliary instruments of various kinds.

Adjustment of Observations. Observations of a geodetic nature will be considered, or this work may be made to apply to other lines of investigation if desired, such as physics, mechanics, and hydraulics. A general treatment of the method of least squares may be given if desired.

Terrestrial Magnetism. A Kew magnetometer, a Barrows dip circle, and a declinometer afford means for investigating the magnetic elements.

Gravity. One of the piers of the department has been occupied as a gravity station by the United States Coast and Geodetic Survey, and is therefore connected, through Washington, with the absolute determinations made at Potsdam, Germany.

The instrumental equipment for this class of work includes, besides a Kater pendulum, a Mendenhall half-second pendulum apparatus of the pattern used in the United States Coast and Geodetic Survey, the pendulums being swung in a partial vacuum. The literature of this subject is well represented in the library.

Standards of Length. For the study and comparison of measures of length, the metric laboratory is provided with a four-meter comparator with micrometer microscopes and carriage movable transversely to accommodate two or more measures simultaneously, an ice-bar apparatus, etc. This comparator is in a case for protection from sudden changes of temperature, and the laboratory temperature is nearly constant. A four-foot comparator is available for the direct study and graduation of leveling rods.

For the investigation of the behavior of apparatus, especially tapes, under field conditions, and also for the standardization of tapes, a 100-meter comparator has been constructed and the auxiliary instruments are in process of manufacture. The end marks are underground and well isolated from surface disturbance. Micrometer microscopes on the piers above these marks will be referred to them by means of special plumbing apparatus, the tapes being observed directly through the microscopes. In this work, a 50-meter Invar tape will be used, whose standardization has been made with exceptional precision by the National Bureau of Standards.

The graduation of scales, as well as their study, is facilitated by means of a dividing engine made by the Société Générale. For the most delicate graduation work, the large Rogers dividing engine in the Department of Physics is available.

The laboratory standard of length is a steel meter bar of the international type, by the Société Générale. It has been compared with an international prototype at Washington. A Rogers four-inch and decimeter scale on speculum metal, accurately compared, and a brass line-and-end-measure yard are also available.

Investigation of Instruments. In addition to the special equipments mentioned above, considerable apparatus of an auxiliary character for the investigation of instruments is at hand. Notable pieces are the large Dodge-Mayhew level-trie, a spherometer with special adaptation for the study of pivots, a pair of pier collimators, micrometer microscopes, etc. Also, there are the usual engineering instruments of many types, transits, theodolites, heliotropes, levels, and meteorological instruments. For standards of temperature, there are several precision thermometers by Boudin, Tonnelot, and others, some of which have been standardized at the International Bureau at Paris. A special comparator is available for the calibration of thermometers, and there is a pyrometer for the study of high temperatures.

The work arranged especially for graduate students may be divided into the following courses:

- a. Theory of Least Squares and Adjustment of Observations.
- b. Theoretical Geodesy and Geodetic Methods.
- c. Advanced Geodetic Astronomy.
- d. Geodetic Laboratory and Field Investigations.

The character of the work, as well as the amount of time to be devoted to it, will be arranged with each student. It is usually desirable that the theoretical

reading be accompanied by illustrative laboratory practice, and in the more advanced portions of his work the student will generally devote most of his time to special investigations.

The preparation necessary for graduate work in geodesy and astronomy should include, in particular, general courses in physics, chemistry, and mathematics (including differential and integral calculus), as well as the usual undergraduate work in surveying and mechanics. The ability to read German scientific work is almost indispensable.

Elementary Surveying; Advanced Surveying; Topographic, Hydrographic, and Geodetic Survey (Camp); Survey Computations and Mapping.

Least Squares; Adjustment of Observations. Assistant Professor UNDERWOOD.

Advanced Topographic Surveying. Assistant Professor LELAND.

Geodesy and Geodetic Laboratory. Assistant Professors LELAND and UNDERWOOD.

Geodetic Astronomy. Assistant Professor LELAND.

Applied Mechanics and Hydraulics

Professors: I. P. CHURCH; S. G. GEORGE; A. P. MILLS; E. W. RETTGER; E. M. SCHODER; F. J. SEERY; K. B. TURNER.

Instructors: C. M. BAKER; J. F. BRAUNER; N. W. DOUGHERTY; CARL CRANDALL.

The technical library in Lincoln Hall contains a full collection of the important books dealing with applied mechanics and hydraulics, complete sets of all representative engineering periodicals, journals of the principal technical societies, and government reports on technical investigations.

The Cement Laboratory contains machines for tension tests, compression machines of from two to two hundred tons capacity, and an impact machine. For direct experiment with cement there is also provided a large number of tension and compression briquette moulds, a water tank with capacity for the storage of three thousand briquettes, a moist oven with a capacity of seven hundred briquettes, and three drying ovens; scales; slate and plate-glass mixing tables, thermometers, a Bunsen pump for determining permeability, several sets of apparatus for measuring linear and volume changes during setting, and apparatus for determining specific gravity, normal consistency, and time of set, and constancy of volume by normal and accelerated tests; also standard sieves for determining fineness, and apparatus for determining voids in sand and stone.

The Equipment of the Testing Laboratory for materials of construction and for full sized members, joints, and structures includes a Riehle 400,000 lb. testing machine with a capacity for beams and girders up to 19 inches in width and to 18 feet in length and for specimens in tension and compression up to 12 feet in length; a Riehle 100,000 lb. testing machine, and an Olsen 50,000 lb. machine; an Olsen 10,000 lb. wire testing machine; a Thurston autographic torsion testing machine; a Riehle torsion testing machine of 60,000 inch-pounds capacity, for testing rods and shafts up to one and a half inches in diameter and six feet in

length; a Riehle 5,000 lb. transverse load testing machine for flexural tests of bars of wood and metal up to four feet in length; an Amsler-Laffon compression testing machine; a standard Page impact machine for tests of road material; a Riehle grinder for stone specimens; a standard Deval machine for abrasion tests of road material; and a standard rattler for paving brick.

The equipment also includes a set of torsion clinometers for use with the Riehle torsion machine; a Henning extensometer for tension tests of metals, and two self-indicating dial extensometers with fittings which adapt them for use in testing steel or iron tension or compression specimens, and also for testing full sized concrete beams and columns and for tests of wire. The Martens mirror extensometer is also available. Knock-down forms are provided for the making of large concrete beams and columns.

Mechanics of Engineering. Professor CHURCH, Assistant Professors GEORGE, TURNER, and RETTGER, and Messrs. BRAUNER and DOUGHERTY.

Materials. Laboratory. Professor CHURCH, Assistant Professor MILLS, and Messrs. BRAUNER, DOUGHERTY, and BAKER.

Hydraulics. Professor CHURCH and Assistant Professors GEORGE, RETTGER, SCHODER, and TURNER.

Materials of Construction. Assistant Professor MILLS, and Mr. BRAUNER.

Advanced Mechanics. Professor CHURCH and Assistant Professor RETTGER.

Special Courses in Advanced Mechanics for Graduates. Professor CHURCH.
Engineering Problems. Professor CHURCH, and Assistant Professors GEORGE, RETTGER, and TURNER.

Testing Materials. Professor CHURCH, Assistant Professor MILLS, and Mr. DOUGHERTY.

Hydraulic Constructions. Assistant Professor SEERY.

Water Power Engineering. Assistant Professor SEERY.

Engineering Design in Hydraulic Engineering. Professor CHURCH and Assistant Professors GEORGE, TURNER, and RETTGER.

Experimental Hydraulics

Professors: E. E. HASKELL; E. W. SCHODER; K. B. TURNER.

The Hydraulic Laboratory by reason of its unique location and unusual facilities is adapted to investigations of great value to hydraulic science and the engineering profession. The water supply is obtained from Fall Creek with a watershed of 126 square miles. Beebe Lake, a pond of about 20 acres, has been formed by the construction of a concrete dam 26 feet high, with a spillway crest length of 130.5 feet. At one end of the dam there is an additional flood spillway 141.5 feet long. A rectangular canal 420 feet long and 16 feet wide is supplied from Beebe Lake through six headgates for controlling the amount of flow. The upper portion of the canal is 17.7 feet deep and the lower portion is 10 feet deep. In this canal are two sharp crested weirs 16 feet long over which discharges as large as 400 cubic feet per second may be passed.

A short branch canal 6 feet wide, in the upper portion of the laboratory building, may be supplied directly from Beebe Lake by means of a 48-inch cast iron pipe line with a short 30-inch branch at its lower end. A 30-inch valve controls the flow from the 48-inch pipe into the 6-foot canal. The 6-foot canal discharges

either to waste into the pool below Triphammer Falls (a sheer drop of 60 feet) or into the upper end of a steel stand-pipe 6 feet in diameter and 60 feet high. A suitable mechanism causes an instantaneous diversion of discharges as large as 60 cubic feet per second from the waste flume into the standpipe or vice versa. The 6-foot standpipe is provided at the bottom with a 36-inch discharge valve operated by hydraulic pressure. There is a float gauge indicating accurately the height of the water surface in the standpipe. An independent 10-inch pipe line from Beebe Lake to the bottom of the laboratory supplies the majority of the pieces of apparatus used for class work and research. The 6-foot standpipe may be used also as a supply tank, water being supplied to it either from the 6-foot canal or the 10-inch pipe line.

The lower portion of the large 16-foot canal, 300 feet long between weirs, is used for measurements with floats and current meters. An electrically operated car spans this canal and is used for rating the current meters. Models of dams may be built in the canal and the flow over them investigated with precision.

There is an outdoor equipment for pipe-flow experiments with pipes as large as 6 inches in diameter with a concrete tank for precise measurements of flow. The 8-inch pipe line supplying the university filtration plant is available for experimentation, giving a head of 225 feet.

Prospective graduate students should bear in mind that only under very rare circumstances can a candidate for the Master's degree, or even the Doctor's degree, hope to handle an experimental investigation in hydraulics involving large flows of water up to the capacity of the laboratory or involving extensive constructions. The limitations of seasonal availability of water and of weather conditions, as well as of time, labor, and expense, are such that the graduate student in this subject should look forward to investigations of lesser apparent magnitude, but often of equal value.

Hydraulic Measurements. Assistant Professors SCHODER and TURNER.

Experimental Hydraulic Motors and Pumps. Assistant Professors SCHODER and TURNER.

Experimental Hydraulic Investigation. Assistant Professor SCHODER.

Advanced Experimental Hydraulics. Professor HASKELL and Assistant Professor SCHODER.

Sanitary Engineering

Professors: H. N. OGDEN; C. L. WALKER.

The courses offered to graduate students may be divided into two classes: those dealing with the design, construction, and operation of sewage disposal plants and of water purification plants; and those fundamental studies in chemistry, biology, and bacteriology, which the undergraduate student in civil engineering may not have been able to pursue.

A sewage-disposal plant in the city of Ithaca offers opportunity for experimental study of septic action and of sedimentation. Within a short distance from Ithaca are five other plants, well adapted for critical examination of efficiencies. Numerous other opportunities are offered for the study of similar questions.

The laboratories in all the related subjects are open to graduate students in sanitary engineering. The courses in organic chemistry are well adapted

to the study of the disposal of trade wastes. The courses in mycology and botany afford excellent opportunity for studying the life history of algæ and other water plants which affect both stream pollution and purification. The courses in bacteriology deal not only with water bacteria and the colon types but also with pathogenic forms interesting from the point of view of epidemiology. The courses in the Medical College enable the student to trace the effect of the pollution of water supply and to acquire a working knowledge of the water-borne diseases. Finally, a well equipped sanitary laboratory, established in the College, gives an opportunity for students to acquire not merely laboratory technique in water analysis, but also a practical training in the forms of interpretation. This laboratory is also available for experimental studies of the efficiency of water and sewage plants and of methods of dealing with the refuse from factories. The library is well provided with the literature of the various subjects bearing on municipal sanitation.

The following courses in other subjects in the University may profitably be taken by graduate students in sanitary engineering: History and Political Science, course 76a; History and Political Science, course 96; Chemistry, course 30; Chemistry, course 75; Botany, course 11; Entomology, course 19; Medical College, course 43.

Railroad and Highway Engineering

Professors: C. L. CRANDALL; F. A. BARNES.

Instructors: W. L. CONWELL; E. C. WHITE.

The library contains an excellent collection of books, periodicals, and proceedings of engineering societies on railroad construction and operation covering American and European practice for both steam and electric roads. Surveys and maps of locations made by the undergraduate classes during many years form an excellent basis for study and for comparison of alternative routes with existing lines. Standard plans and other data have also been contributed from time to time by railroad companies and others for the use of the department.

The college laboratories for experimental hydraulics and cement work, and for the study of the strength and other properties of the materials for track and structures, are available for those specializing in this field.

Railroad Surveying, Construction and Economics. Prerequisite for graduate work.

Railroad Maintenance of Way. Professor CRANDALL.

Railroad Operation and Management. Assistant Professor BARNES.

These two courses will not be accepted as part of a major subject unless they are accompanied by special work and reports.

Railroad Engineering Design. Professor CRANDALL, Assistant Professor BARNES.

Highway Engineering. Professor CRANDALL, Mr. CONWELL.

Highway Engineering Design. Professor CRANDALL, Mr. CONWELL.

Special Courses. Special courses of investigation and study will be arranged to meet individual needs.

Attention is called to the facilities available in other departments of the University to supplement the work above outlined, as for example, in political science the course on railroad transportation and, in electrical engineering, courses dealing with the application of electricity to the operation of railroads.

Bridge Engineering

Professor: H. S. JACOBY.

Instructors: E. N. BURROWS; F. A. HITCHCOCK; L. C. URQUHART; W. E. BEITZ.

In this subject, instruction is offered in the determination of loading, stresses, and design of roofs, buildings, bridges, arches, foundations, piers, retaining walls, and other structures of timber, steel, reinforced concrete, and masonry.

A collection of over seven thousand blue prints is available, giving detail plans of American railroad and highway bridges, roof trusses, steel buildings, and various structures of reinforced concrete and masonry, and there are also about one thousand selected photographs of all classes of bridges designed in this country.

The twenty-six bound volumes of blue prints used for office reference by the late George S. Morison, which contain the plans of all the bridges designed under his direction as consulting engineer, form a part of the reference library.

The library contains practically all of the important books on bridge and structural engineering. It also contains a valuable collection of theses, those on original investigations relating to arch bridges being especially noteworthy. These investigations have been conducted so as to form an extended and closely related series. Their results constitute an important addition to previous knowledge of the relative strength, stiffness, and weight of different types of construction, and of the methods for their investigation and design. Special facilities are available for the study of secondary stresses in bridge trusses.

To qualify for graduate work in bridge engineering, a knowledge of theoretical mechanics, of the strength of materials, and of engineering construction is required in addition to the preliminary course in structural design named below.

Structural Details, Bridge Stresses, and Bridge Design.

Reinforced Concrete Arch. Professor JACOBY and Messrs. BURROWS and URQUHART.

Higher Structures. Professor JACOBY.

Masonry and Foundations. Professor JACOBY.

Steel Buildings. Mr. HITCHCOCK.

Concrete Construction. Messrs. BURROWS, HITCHCOCK, and URQUHART.

Engineering Design. Professor JACOBY.

ARCHITECTURE

Professors: C. A. MARTIN; O. M. BRAUNER; G. MAUXION; A. C. PHELPS;
GEORGE YOUNG; CHRISTIAN MIDJO; E. R. BOSSANGE.

Instructors: H. S. GUTSELL; G. R. CHAMBERLAIN; H. E. BAXTER; D. C.
COMSTOCK.

Graduate work is offered in architectural design; in the history of architecture, painting, and sculpture; in advanced construction; and in drawing, painting, and modeling in their relation to design in architecture.

Candidates for the Master's degree in architecture must be graduates of schools of equal standing with the College of Architecture, and their training in design or other subjects elected for graduate work must be equivalent to the training required in like subjects in this College for the degree of Bachelor of Architecture.

The equipment and facilities within the limits of the work offered or undertaken are of the highest order. In addition to the library and rooms used for lectures, recitations, exhibition purposes, offices, etc., the College has nearly fifteen thousand square feet of floor space in studios devoted exclusively to the work in design and drawing. The large studios for the work in drawing from the antique, still life, and from life, are thoroughly equipped with full size plaster casts—several hundred in all—of sculpture from the best periods of the art; particularly from the Greek, Roman, and Italian Renaissance, with examples from the medieval and later Renaissance periods. The equipment for the work in color and modeling, which are taken only as minor subjects, is also excellent.

Supplementary to the equipment provided by the University Library there is a special library of works on architecture and the allied arts, surpassed in size by only one other in the country and surpassed by none in its accessibility and direct usefulness as a working and reference library. In addition to the books, portfolios, pamphlets, etc., there are several thousand choice photographs covering the entire field of architecture, about one thousand fine color reproductions of the masterpieces of painting, some nine thousand carefully selected lantern slides, and many original drawings made by masters of design and draftsmanship in architecture, all of which are directly accessible to the student.

All instruction is by direct and personal elbow-to-elbow discussion and criticism that gives to each pupil the utmost that his teachers and advisers have to give.

Freehand Drawing; Descriptive Geometry; History of Ancient and Medieval Architecture; Elements of Architecture; Shades and Shadows; Water Color Painting; History of Renaissance Architecture; Design; Drawing from the Antique; Masonry Construction; Perspective; Historic Ornament; History of Greek Sculpture and Italian Painting; History of Art in Italy; History of Art North of the Alps; Modeling; Planning of Domestic Buildings; Specifications; Working Drawings; Mechanics, Strength of Materials, Structural Design, etc.; Modern Architecture; Advanced Design; Life Class; Seminary; Historical Seminary; Fire-resisting Construction.

Graduate students who are candidates for the degree of Master of Architecture may elect from the following subjects, but in any case the major subject must be Design or the History of Architecture.

Architectural Design. Professors MAUXION and BOSSANGE.

History of Architecture. Professor PHELPS.

Construction. Professors MARTIN and YOUNG.

Drawing from Life. Professors BRAUNER and MIDJO.

Painting. Professors BRAUNER and MIDJO.

Modeling. Professor MIDJO.

Decoration. Professor MIDJO.



OFFICIAL PUBLICATIONS OF CORNELL UNIVERSITY

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These publications include

Catalogue Number (containing lists of officers and students), price 25 cents,
Book of Views, price 25 cents.

Directory of Faculty and Students, Second term, 1913-14, price 10 cents,
and the following informational publications, any one of which will be
sent gratis and post-free on request. The date of the last edition of
each publication is given after the title.

General Circular of Information for prospective students, February 1, 1914.

Announcement of the College of Arts and Sciences, May 15, 1913.

Announcement of Sibley College of Mechanical Engineering and the
Mechanic Arts, January 1, 1914.

Announcement of the College of Civil Engineering, February 15, 1914.

Announcement of the College of Law, April 15, 1913.

Announcement of the College of Architecture, June 1, 1913.

Announcement of the New York State College of Agriculture, June 15, 1913.

Announcement of the Winter Courses in the College of Agriculture, July 1,
1913.

Announcement of the Department of Forestry, July 15, 1913.

Announcement of the Summer School in Agriculture, April 1, 1913.

Announcement of the New York State Veterinary College, March 1, 1913.

Announcement of the Graduate School, January 15, 1914.

Announcement of the Summer Session, March 15, 1913.

Annual Report of the President, November 1, 1913.

Pamphlets on scholarships, fellowships, and prizes, samples of entrance and
scholarship examination papers, special departmental announcements, etc.

Correspondence concerning the publications of the University should be
addressed to

The Secretary of Cornell University,

Ithaca, New York.